



REPRINTED FROM

GUY'S HOSPITAL REPORTS.

VOL. LVI.

ON ENTERIC FEVER:

BEING

AN INVESTIGATION INTO THE BACTERIOLOGICAL
CONDITION OF THE URINE, AND IN SOME CASES,
OF THE KIDNEY IN THIS DISEASE.

(THESIS FOR THE M.D. CAMBRIDGE.)

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IN bringing before you this paper on the result of some investigations into the bacteriology of the genito-urinary tract in enteric fever, I will not venture to apologise for its shortcomings, nor for its inadequacy, because of these I am fully conscious. The subject is one which demands more attention than has hitherto been bestowed upon it, both from a clinical, pathological, and public health point of view. Very little help is to be obtained from the literature, which at present is but scanty. The earlier publications are of little use, since our bacteriological knowledge was not then sufficiently advanced to satisfactorily differentiate the micro-organism found. Krogus, writing on the subject of bacteriuria, bases his remarks upon eight cases, in which he examined the urine under aseptic conditions. In each of these cases he states that he found the bacillus coli communis. He has, however, given but scanty proof of the identity of the organism found. For example, in

Observation II. his proof of the presence of the bacillus coli communis is given in the following words: "l'ensemencement de l'urine sur des plaques de gélatine, donna lieu au développement d'innombrables colonies du bacterium coli commune," and in Observation III. "Sur les plaques de gelatine, il se dévelop্পé le bacterium coli commune en culture puré." In none of the cases can I find that he published any further proof of the identity of the organism found, although he is quoted as having made most careful bacteriological examinations.¹ In another case, published as late as 1898, in speaking of the bacillus coli communis, the author says, "the bacteria were motile and otherwise characteristic."² The later publications seem to shew that the urine of patients suffering from enteric fever contained the bacillus typhi abdominalis in about twenty-five per cent. of cases. In the few cases that I have examined, the results have shown a lower percentage than this.

My own object has been to examine into the bacteriological condition of the urine in enteric fever, from the earliest possible period in the disease, to carry on this investigation during the whole period that the patient remained in hospital under treatment, and in cases where death has occurred, to make examinations of the viscera as early as possible after death. Bacteriological examinations were made of the heart-blood or spleen, the kidneys, and the urine in the bladder. Sections of the kidneys were also made and examined for micro-organisms, with the idea of finding, if present, their position in these organs, and whether in the tubules, glomeruli, or in both.

From the small number of cases that I have been able to examine, I am afraid that any deduction would be presumptuous. But I think, as far as it is possible, under the circumstances under which these examinations can be made, that the few facts I have gleaned are reliable.

¹ A. Krogius. Sur la bacteriurie, Annales des Organ. Gén-Urin., 1894, p. 196, et seq.

² Nathan, P. W. Bacillus coli communis in the urine, and its significance. Med. Rec., New York, 1898, vol. liii., 83-86.

METHODS ADOPTED IN THE BACTERIOLOGICAL
EXAMINATION OF THE URINE, KIDNEYS AND OTHER
VISCERA, AND THE BLOOD, IN ENTERIC FEVER.

The Bacteriological Examination of the Urine.—In the case of male patients the glans penis and meatus urinarius were washed with a solution of mercuric chloride (1—2000), or with lysol 2 per cent. The urine was then passed (the first portion being rejected, as likely to contain organisms that might be present in the urethra) into a sterilized flask, which was immediately closed with its sterilized plug of cotton wool.

In the case of female patients, the urine was drawn off by a catheter, passed by a reliable nurse, the parts being first cleansed with a solution of mercuric chloride (1—2000). Some of these catheter specimens obtained by the nurse in this way were found to be quite sterile. I have mentioned this fact, in order to point out that the specimens obtained in this manner can be relied upon equally with those obtained from male patients.

In each case hanging drop examinations of the urine were made. 5 c.c. of the urine were pipetted, with a sterile pipette, into tubes of broth and glucose-formate broth respectively. An agar plate was made and some urine spread over the surface, every means being adopted to prevent the entrance of adventitious organisms. The glucose-formate broth tube was incubated in every case anærobically, a Buchner's tube being used.

All three media were incubated for twenty-four hours and two days at 37° C. At the end of these times they were examined, hanging drop preparations being made, and films being stained with carbol-methylene blue, and if bacilli were found, by Gram-Weigert's method.

Agar plates were then made, and if more than one organism was present, separation was thus effected. In some cases it was found necessary to replato several times, in order to obtain the organisms in pure culture.

When micrococci only were found, they were not worked out. When pure cultivations of bacilli were found, the organism was worked out according to the following scheme:—

Description.—Whether coccus, bacillus, etc.

Motility.—Whether non-motile, slightly motile, very motile, etc.

Spores.—Presence or absence of.

Staining reactions.—With carbol methylene blue, carbol fuchsin, Gram-Weigert.

Pleomorphism.—Any signs noted.

Cultural reactions.—The growth of the organism in broth and peptone water. These were examined at the end of five days for the production of indol, recognised by the fact that when acted upon by nitric acid in the presence of nitrites, a nitroso-indol compound is produced, which has a very red colour. (By using commercial nitric acid, which contains nitrous acid as an impurity, this experiment can easily be performed.)

The reactions of the organism when grown upon lactose broth,³ formate broth, dextrose broth, saccharose broth, glycerine broth, nitrate broth, lead broth (for detection of sulphuretted hydrogen), litmus milk, and glucose-formate broth grown anærobically.

The characters of the growth upon agar, blood-serum and potato. All of the above were incubated at a temperature of 37° C. The growth of the organism upon gelatine (stab, streak, and plates), at a temperature of 20° C., was also investigated, and the presence or absence of gas-production, or of liquefaction was especially noted.

All were examined at the end of twenty-four hours, and at the end of two, three and five days. An examination was made earlier than twenty-four hours, in dextrose broth cultures for gas-formation, and motility, and later than twenty-four hours in the case of milk for the occurrence of clotting.

Bacteriological examination of the kidney.—The following procedure was adopted in the bacteriological examination of the

³ Lactose broth, dextrose broth, formate broth, saccharose broth and glycerine broth, as well as litmus milk, were coloured blue with litmus, any formation of acid being indicated by a change in colour.

kidney. The kidney was removed from the body as soon as possible after death, the capsule was then stripped off, and the surface of the kidney seared with a hot iron and thus sterilized ; an incision was next made with a sterilized knife into the kidney substance, and a scraping was taken with a sterilized platinum wire loop, and planted in broth and glucose-formate broth, and on sloped agar. Direct films were also made, stained, and examined for micro-organisms. The media after inoculation were incubated at 37° C. for twenty-four hours and then examined. Hanging drop preparations were made and examined. Films were stained with carbol-methylene blue, carbol-fuchsin, and by Gram-Weigert's method.

Plate preparations on agar were now made, and if more than one organism was found, separation was thus effected. The same routine method of working out the organisms was adopted in all the cases.

The bacteriological examination of the spleen was carried out in a similar manner.

In the bacteriological examination of the heart-blood, the pericardium was opened, and the surface of the heart sterilized with a hot iron. A sterilized pipette was plunged through the wall of the ventricle, and some blood sucked into it. The fine end was then hermetically sealed, until the blood thus obtained was required for cultivation.

In the bacteriological examination of the urine from the post-mortem bladder, the surface of the bladder was sterilized with a hot iron, an incision was then made into it, sufficiently large for the introduction of a sterilized pipette, some urine being withdrawn, collected in a sterilized flask, and examined as described above.

Histological examination of the kidney.—In each case the kidney was examined as soon as possible after death, both to avoid, as far as one could, the presence of micro-organisms due to post-mortem changes, and the post-mortem changes in the kidney cells.

A suitable portion of the kidney was hardened, by placing it for twelve hours in a saturated solution of mercuric chloride. It

was then immersed in equal parts of spirit and water for a few hours, then in spirit for a few more; after that it was dehydrated with absolute alcohol, and cleared with xylol. From this it was transferred to a paraffin bath, heated to 56° C. for twenty-four hours. The portion of the kidney was then embedded in paraffin, and sections were cut with a microtome. These were stained with carbol-thionin blue, and examined carefully for micro-organisms under a one-sixth inch lens and under a one-twelfth inch oil immersion lens.

BACTERIOLOGICAL REACTIONS OF THE BACILLUS TYPHI ABDOMINALIS.

The following reactions have been taken to indicate the presence of the bacillus typhi abdominalis.

A bacillus, which is motile, which stains with carbol-methylene blue, and which is decolorized by Gram-Weigert's method. Which gives no indol reaction when cultivated on broth and peptone water, and tested with nitric acid in the presence of nitrites.

Which gives rise to no gas-formation when grown in formate broth, dextrose broth, lactose broth, saccharose broth, glycerine broth, or glucose-formate broth; this last grown anærobically.

Which produces nitrites when grown in nitrate broth, as shewn by producing a ruby-red colour when tested with metaphenylene diamine.

Which produces neither gas nor liquefaction when cultivated on gelatine; which, when grown on sloped gelatine, produces a whitish semi-translucent growth, with dentate edges.

Which gives a whitish semi-translucent growth on agar. Which produces slight acidity, but no clotting of milk. Which produces no spores. The non-production of spores is proved by exposing a twenty-hours' broth culture to temperature 80° C. for twenty minutes, and inoculating from this with a negative result. Of which a twenty-four hours' growth on broth becomes clumped when examined with serum from a typhoid patient, which has

caused clumping of a known bacillus typhi abdominalis grown in the same way. (Gruber's reaction).

By an atypical typhoid bacillus is meant an organism which differs from a typical typhoid bacillus in one principal reaction, while agreeing in other respects.

By a para-typhoid bacillus, an organism which differs from a typical typhoid bacillus, in two principal reactions, while agreeing in other respects.

The bacilli described in this paper as atypical bacillus coli communis and para-colon bacillus differ from the normal bacillus coli communis according to the same rules.

BRIEF ABSTRACT OF CASES.

Fifteen cases of enteric fever were examined. In one of these the kidney only was examined. In ten cases the urine only was examined, several examinations being made in each case. In three cases in which death occurred, the kidney, spleen, or heart-blood, and the urine from the post-mortem bladder were examined. In one case the urine was examined during the period of convalescence only.

CASE 1.—F., 28 years. Signs: Fever, enlargement of spleen, rose-red spots on abdomen, bronchitis, feeble pulse. Death seven days after admission. No Widal reaction performed. Post-mortem signs of enteric fever found. Kidney sterile. Histological examination, nil.

CASE 2.—M., 31 years. Bacteriuria occurred for ten months after an attack of enteric fever; it was arrested by urotropin. Four examinations of the urine were made during a period of three months. The bacillus coli communis and an atypical bacillus coli communis were found. After administration of urotropin, the urine became sterile.

CASE 3.—F., 9 years.—Enteric fever with relapse. Signs: Fever, enlargement of spleen, spots on abdomen, and a positive Widal reaction. Urine examined on thirty-fifth day (eighth day of relapse), sterile. Examined on thirty-ninth day, staphylococci.

CASE 4.—M., 21 years. The history points to the fever on admission being due to relapse, after a primary attack of a fortnight's duration. Signs: Fever, diarrhœa, and fulness of abdomen. Widal's reaction present. Urine examined three times during first, second, and fourth weeks. Staphylococci only on each occasion.

CASE 5.—F., 32 years. Signs: Fever, rose-coloured spots on abdomen, diarrhœa, a palpable spleen, some signs of bronchitis and a marked Widal reaction. Urine examined on five occasions, on the twenty-fifth day (sterile), twenty-seventh day (staphylococci), thirty-fourth day (staphylococci), forty-first day (sterile), fifty-fifth day (cocci).

CASE 6.—M., 27 years. Signs: Fever, diarrhœa, pain in head and abdomen, rose-coloured spots, dicrotic pulse, signs of bronchitis, and a positive Widal reaction; urine examined twice (during convalescence), staphylococci only found.

CASE 7.—M., 29 years. Signs: Fever, spots, and palpable spleen. Death occurred from hæmorrhage of the bowel during a probable relapse. Widal's reaction negative. The post-mortem signs of enteric fever were found. Bacteriological examinations were made of the spleen, kidney, and urine from the post-mortem bladder. The bacillus typhi abdominalis was found in pure culture in spleen. The kidney was sterile. The urine from the post-mortem bladder contained only staphylococci.

CASE 8.—F., 4 years. Signs: Fever, diarrhœa, fulness of abdomen, rose-coloured spots, and a positive Widal reaction. Five examinations of the urine were made (1) on the eighth day, a para-colon bacillus, (2) on the fifteenth day, a bacillus resembling in many respects the bacillus enteritidis of Gärtner, (3) on the twentieth day the bacillus typhi abdominalis, (4) on the thirtieth day, the bacillus proteus vulgaris, (5) on the forty-seventh day, both the bacillus coli communis and bacillus proteus vulgaris.

CASE 9.—M., 16. Signs: Fever, typhoid spots, constipation, spleen not palpable and a positive Widal reaction. Six examinations of the urine were made, on the thirteenth, eighteenth, twenty-first, twenty-fourth, twenty-seventh, and fortieth days. On five occasions staphylococci were found, and on the sixth, cocci which were arranged in pairs.

CASE 10.—M., 11. The temperature after being raised for three weeks became normal, but a relapse occurred with pyrexia of slight degree continuing for another three weeks. Spleen palpable, spots present on abdomen. Widal's reaction present. Urine examined four times, on the twenty-fifth, twenty-ninth, thirty-ninth, and forty-seventh days, respectively. Staphylococci only were found.

CASE 11.—M., 25 years. Signs: Fever, diarrhœa, enlargement of spleen, absence of spots, fulness of abdomen. Widal's reaction was present. Three examinations of the urine were made. On the first examination a para-typhoid bacillus found, on the second, staphylococci, on the third, a bacillus of the proteus group.

CASE 12.—F., 30 years.—Signs: General malaise, fever, diarrhœa and constipation alternating, enlargement of spleen, rose-coloured spots on abdomen. The blood was negative to Widal's reaction. Urine examined on four occasions: On twentieth day bacillus typhi abdominalis with staphylococci; on forty-third day bacillus typhi abdominalis in pure culture; on forty-seventh day cocci and some large bacillus, not the bacillus typhi abdominalis; on fifty-first day bacillus typhi abdominalis, with a proteus-like organism.

CASE 13.—M., 19 years; a severe case, with fever, headache, delirium, fulness of abdomen, rose-coloured spots. The spleen was not palpable. Widal's reaction negative. Death occurred from perforation. Bacteriological examination of the (post-mortem) urine, spleen and kidney, showed the presence in each, in pure, culture of a para-colon bacillus.

CASE 14.—M., 34 years. Signs: Fever, alternating diarrhœa and constipation, palpable spleen, rose-coloured spots on abdomen. Death occurred from hæmorrhage. Urine from bladder (post-mortem) was sterile. No satisfactory bacteriological examination could be made of the spleen and kidney.

CASE 15.—M., 11 years. Signs: General malaise, fever, slight fulness of abdomen, palpable spleen, and suspicious spots on abdomen. Widal's reaction present. Urine examined on three occasions. Staphylococci only found. The blood was examined bacteriologically and found to be sterile.

DISCUSSION OF CASES.

Forty-five complete bacteriological examinations of the urine were made. Of these, forty-two were made from the urine during life, and three were from the bladder after death.

The earliest examination of the urine was made on the eighth day of the disease, the bacillus para-coli communis being found. The earliest day on which the bacillus typhi abdominalis was found in the urine, was on the twentieth day of the disease (in two different cases of enteric fever, it was found on the twentieth day). The latest recorded examination was made on the fifty-first day of the disease, the bacillus typhi abdominalis being found, together with an organism giving the reactions of the proteus vulgaris. The latest day on which the bacillus typhi abdominalis was found in the urine, was therefore the fifty-first day of the disease. Since patients leave the hospital during convalescence, no attempt has been made to discover the period during which the bacillus typhi abdominalis may remain in the urine. A glance at Case 2 will show, however, that bacteriuria (in this case due to the bacillus coli communis) may continue for several months after the temperature has become normal.

The organisms found in the urine, in enteric fever patients, include the following:—

	Organism found.	No. of examinations of urine in which the organism was found.
1	Bacillus Typhi Abdominalis	4
2	" Para-typhi Abdominalis	1
3	" Coli Communis	3
4	" " " (atypical)	4
5	" Para-coli Communis	2
6	A bacillus resembling in many respects the Bacillus Enteritidis of Gärtner. ...	1
7	Bacillus Proteus Vulgaris	3
8	Staphylococcus	23
	Total	41
	No. of examinations in which urine was found to be sterile.	5

NOTE 1.—In some cases two different organisms were found in the same specimen of urine.

NOTE 2.—The condition of the urine showed in most cases but little departure from the normal. At most but a slight trace of albumin was present, and in all the urine was acid.

In three cases, a bacteriological examination of the kidney was made on post-mortem examination.

In the first case (Case 1) the kidney only was examined, and was found to be sterile.

In the second case (Case 7), the kidney was found to be sterile, and the spleen contained the typhoid bacillus in pure culture. The urine in this case was unfortunately not examined during life. A specimen taken from the post-mortem bladder contained staphylococci only.

In the third case (Case 13), the kidney and spleen, as well as a specimen of the urine from the post-mortem bladder, were examined. All contained the para-colon bacillus in pure culture. The urine in this case had not been examined during life.

In fourteen cases bacteriological examinations were made of the urine.

A.—In ten cases bacteriological examinations were made during the course of the disease, or during the period of convalescence immediately following :—

In the first case of this series (Case 3), two examinations were made, the first on the thirty-fifth day (eighth day of relapse), when the urine was found to be sterile; the second, on the thirty-ninth day, when the urine was found to contain staphylococci.

In the second case (Case 4), three examinations were made during the first, second and fourth weeks. Staphylococci only were found.

In the third case (Case 5) five examinations were made, on the twenty-fifth day, when the urine was found to be sterile, on the twenty-seventh and thirty-fourth days, when staphylococci were found, on the forty-first day, when the urine was found to be sterile, on the fifty-fifth day, when cocci were found.

In the fourth case (Case 6), two examinations were made during convalescence, in both of which staphylococci were found.

In the fifth case (Case 8), five examinations were made. The first on the eighth day, on which the bacillus para-coli communis was found. The second, on the fifteenth day, in which a bacillus was found, resembling in many respects the bacillus enteritidis of Gärtner. The third, on the twentieth day, on which the bacillus typhi abdominalis was found in pure culture. The fourth, on the thirtieth day, when the bacillus proteus vulgaris was found. The fifth on the forty-seventh day, when both the bacillus coli communis, and the bacillus proteus vulgaris were found.

In the sixth case (Case 9), six examinations were made, on the thirteenth, eighteenth, twenty-first, twenty-fourth, twenty-seventh and fortieth days of the disease respectively. In the first five examinations staphylococci were found; in the sixth, cocci, chiefly in pairs.

In the seventh case (Case 10), four examinations were made, on the twenty-fifth, twenty-ninth, thirty-ninth and forty-seventh days of the disease respectively. On each occasion staphylococci only were found.

In the eighth case (Case 11), three examinations were made. At the first examination, made during the interval between the primary attack and a relapse, the bacillus para-typhi abdominalis, and also staphylococci, were found. At the second examination, made on the day of the rise of temperature due to relapse, staphylococci alone were found. At the third examination, made on the eighth day of relapse, staphylococci and an organism of the proteus group were found.

In the ninth case (Case 12), four examinations were made, on the twentieth day, when the bacillus typhi abdominalis and staphylococci were found, on the forty-third day, when the bacillus typhi abdominalis was found in pure culture, on the forty-seventh day, when cocci and some large bacilli (not the bacillus typhi abdominalis) were found, and on the fifty-first day, when the bacillus typhi abdominalis and a proteus-like organism were found.

In the tenth case of the series (Case 15), three examinations were made during the third and fourth week of the disease. Staphylococci only were found on each occasion.

B. *In one case (Case 2) bacteriological examinations of the urine were made only some months after the occurrence of the disease.*—Five examinations were made, the first seven months after the attack, the bacillus coli communis being found in pure culture. The second a month later, when an atypical bacillus coli communis was found, also in pure culture. The third, a month after this, when the normal bacillus coli communis was again found in pure culture. The fourth, a month later (ten months after attack), when the atypical bacillus coli communis was again found. After this six ten-grain doses of urotropin were administered, three times a day, for two days. The urine was examined twenty-four hours after administration of the last dose of urotropin, and was found to be sterile. There was no albumin in the urine at any time.

C. *In three cases bacteriological examinations were made from the urine, obtained from the post-mortem bladder. Unfortunately in neither of these cases had examinations been made during life.*

In the first case (Case 7) staphylococci only were found. (The kidney was sterile, the spleen showed the presence of the bacillus typhi abdominalis in pure culture.)

In the second case (Case 13) the bacillus para-coli communis was found in pure culture. (The kidney and spleen also showed the presence of the bacillus para-coli communis in pure culture.)

In the third case (Case 14) staphylococci only were found. (The kidney was sterile and the spleen showed the presence of the bacillus typhi abdominalis in pure culture.)

Proportion of cases of enteric fever in which the bacillus typhi abdominalis was found in the urine. Also the proportion of cases of enteric fever in which some other organisms were found.

In fourteen cases of enteric fever, bacteriological examinations of the urine were made, either during the fever, or during the period following the fall of the temperature, in one case extending to a period of ten months, or from a specimen of urine obtained from the bladder at the post-mortem examination (three cases).

In two cases (14·28 per cent.) the bacillus typhi abdominalis was found. In eight cases (57·14 per cent.) staphylococci (alone) were found. In eleven cases (78·57 per cent.) staphylococci alone, or with some other organism, were found.

The large proportion of cases in which staphylococci were found, lends colour to the suggestion of its being due to accidental contamination, notwithstanding every precaution possible being taken to obtain uncontaminated specimens. This is noticeable in Case 10, a male patient, aged 11 years, where foreskin was long and could not be drawn back, and which made it impossible to cleanse the meatus properly. It was not thought advisable to use a catheter. On reference to the table it will be seen that staphylococci were present on every occasion.

In Case 15, a male patient, aged 16 years, the same condition was present, and in this case also staphylococci only were present at each examination.

The *baeillus typhi abdominalis*, therefore, was found in only 14 per cent. of cases, and in these only at intervals, other organisms, closely approaching it in their bacteriological reactions, being also found. Thus, on reference to Case 8, it is seen, that an atypical *baeillus coli communis* was found on the eighth day of the disease, that a week later another *baeillus*, somewhat resembling the *baeillus enteritidis* of Gärtner, and that a week after this the *baeillus typhi abdominalis* in pure culture was found.

Again, in Case 11, the *baeillus para-typhi abdominalis* was found on one occasion, while on another a *baeillus* of the proteus group was found. It would appear from this, that although the *baeillus typhi abdominalis* is found in the urine of enteric fever patients, that other organisms, approaching it more or less closely in bacteriological reactions, are also found, and in the urine of the same patient.

Arguing from these premises, I would suggest, that if the organisms found in the urine of enteric fever patients be carefully and fully worked out, the percentage in which the *baeillus typhi abdominalis* is found, will be lower than that usually given.

In thirteen of the cases Widal's reaction was performed in the ordinary course of hospital routine. The following method was adopted. It is described by Mr. W. C. C. Pakes, Bacteriologist to Guy's Hospital, to whom I am indebted for the notes of the Widal reactions, and is to be found in an article entitled "Widal's Reaction," in Guy's Hospital Reports, Vol. LV. :—

“The serum is collected in special pipettes, made so that when the blood is collected, it can be allowed to coagulate in the middle, so that the serum can separate, and run down into the finer part, free from corpuscles.”

“*The dilution of the serum.*—In order to dilute the serum, small test-tubes, and small graduated pipettes are used. Ten cubic millimetres of serum are pipetted into a small test-tube, and are mixed with 90 cubic millimetres of broth, which is measured in a second pipette. This gives a fluid containing 10 per cent. of serum : 10 cubic millimetres of this 10 per cent. serum, are all pipetted into a second test-tube, and are mixed with 90 cubic millimetres of broth. This gives a fluid containing 1 per cent. of serum. Sterile broth is used instead of water to prevent the laking of the red discs. It was shewn soon after the reaction was discovered that the red discs contained more of the agglutinius than the clear serum, and if sometimes laked blood is present, and at other times no blood, the observations cannot be said to be made under identical conditions, and the value of the reaction as a diagnostic test will be impaired.”

“*The culture of the bacillus typhi abdominalis.*—The bacilli are inoculated on agar every fortnight, and grown at 20° C. As cultures are required for the reaction, broth tubes are inoculated from the most recent agar culture, about eighteen hours before they are required, the broth tubes being incubated at 37° C.”

“*Mixing the serum with the broth culture.*—Three microscopic examinations have been made latterly, the serum in the mixtures being in the proportion of 50 per cent., 5 per cent., and 0·5 per cent. In order to do this a platinum loopful of the undiluted serum is mixed upon a clean coverslip, with the same loop full of the broth culture, thus making the 50 per cent. dilution. One loopful of the 10 per cent. serum, and of the 1 per cent. serum, mixed with a loopful of the broth culture, form a 5 per cent. and 0·5 per cent. dilution respectively. Immediately after mixing, the coverslips are inverted upon a hanging drop slide, and the time of mixing noted.’

“*The reaction, and reaction time.*—When judging of a reaction it is necessary that practically the whole of the bacilli shall be grouped together, leaving only single bacilli free in the field. If

there are a few small clumps, but the majority of the bacilli are either motile or free in the field, I have called this a half reaction, ' $\frac{1}{2}+$.' As regards the time, I have always been very rigid, and have continued to adopt the time I suggested in 1897, viz., half-an-hour. If there is not a complete reaction within half-an-hour, even if it is complete within one or two hours, I have returned the result as ' $\frac{1}{2}+$,' that is 'no reaction.' "

I have taken a serum clumping in 5 per cent. strength in half-an-hour as being diagnostic of enteric fever as far as the reaction itself is concerned.

WIDAL'S REACTION.*

No. of Case.	Reaction.			Spleen felt.	Typhoid spots.	Results of Urine Examination : Organisms found.
	50 per cent.	5 per cent	0.5 per cent.			
1 i.	—	—	—	Yes	Yes	Bacillus coli communis: atypical bac. col. com.
2 ii.	○	○	○	—	—	
3	+	+	+	Yes	Yes	Staphylococci.
4	+	+	○	No	No	Staphylococci.
5 iii.	—	+	—	Yes	Yes	Staphylococci.
6	+	+	$\frac{1}{4}+$	No	Yes	Staphylococci.
7	○	○	○	Yes	Yes	Staphylococci.
8	○	+	○	No	Yes	Para-colon bacillus. A bacillus resembling in many respects the bac. enteritidis of Gärtner. The typhoid bacillus. Bac. coli com. and bacillus proteus vulgaris.
9 i.	○	$\frac{1}{2}+$	$\frac{1}{4}+$	No	Yes	Staphylococci.
10 ii.	ppt.	+	$\frac{1}{2}+$			
11	○	+	+	Yes	Yes	Staphylococci.
12	+	+	+	Yes	No	Bacillus para-typhi abdominalis. Staphylococci.
13 i.	○	○	○	Yes	Yes	Bacillus typhi abdominalis. Staphylococci. A proteus-like organism, etc.
14 ii.	○	$\frac{1}{2}+$	○			
15 i.	○	○	○	No	Yes	Bacillus para-coli communis.
16 ii.	○	+	○			
17 iv.	—	—	—	Yes	Yes	Sterile (p.m.).
18 i.	○	○	$\frac{1}{2}+$	Yes	Yes	Staphylococci (v.).
19 ii.	+	○	○			
20 iii.	ppt.	$\frac{1}{2}+$	○			
21 iv.	+	+	○			
22 v.	—	++	++			

NOTE i.—No Widal examination made in this case.

NOTE ii.—This serum, although being completely negative in all strengths to the bacillus typhi abdominalis, was found to react fully to a twenty-four hours' culture of

* I have to thank Mr. W. C. C. Pakes for his courtesy in allowing me to publish these Widal reactions.

the bacillus para-coli communis, isolated from the urine of the same case. Its reactions were 50 per cent. = +, 5 per cent. = +, 0.5 per cent. = 0.

NOTE iii.—In this case no Widal examination was made at Guy's Hospital, but a marked Widal reaction was reported from the Jenner Institute.

NOTE iv.—No Widal examination made.

NOTE v.—Finding that staphylococci were so often present, and bacillus typhi abdominalis much less frequently, it occurred to me that the growth of the one might inhibit the growth of the other. In order to find out if such were the case, I inoculated three broth tubes, one with the bacillus typhi abdominalis, one with staphylococcus, and one with a mixture of the two, and placed them under like conditions at 37° C. After seven days' growth, the bacilli were found to be chiefly in evidence.

Bacillus typhi abdominalis.—Broth, 37° twenty-four hours. Turbid, slight sediment. H.D., slightly motile bacilli.

G.F.B., 37° twenty-four hours. Turbid, no gas.

Staphylococcus.—Broth, 37° twenty-four hours. Good growth, turbid, slight sediment. H.D., cocci, chiefly in pairs.

G.F.B., 37° twenty-four hours. Turbid, no gas.

Bacillus typhi abdominalis + *Staphylococcus*.—Broth, 37°, twenty-four hours. Good growth, turbid, slight sediment.

G.F.B., 37° twenty-four hours. Turbid, no gas.

H.D. (broth), bacilli very much more in evidence than cocci. H.D., seven days, bacilli chiefly in evidence.

N.B.—A serum clumping with 5 per cent. in thirty minutes (5 per cent. = +) is taken as alone being positive and diagnostic.

In Case 2 an interesting condition was observed. This case was one in which the patient had had a typical attack of enteric fever some eight months previously. The blood was not examined for the Widal reaction during the attack. Eight months after the attack, however, the serum, on being tested by Widal's method,

with a twenty-four hours' old culture of bacillus typhi abdominalis, was found to give a completely negative reaction in all dilutions. (50 per cent. = 0, 5 per cent. = 0, .5 per cent. = 0). The urine of this patient contained at the time the bacillus para-coli communis. This had been grown in pure culture on gelatine. A broth tube was inoculated from the gelatine, and a twenty-four hours' old culture obtained. This was used with the serum instead of bacillus typhi abdominalis, and was found to give a positive result. 50 per cent. = +, 5 per cent. = +. (Gruber's reaction).

This condition of the blood is, I think, worthy of note, being negative when tested by Widal's method with the bacillus typhi abdominalis, but reacting well with the bacillus para-coli communis, isolated from the urine of the same case.

The question arises whether these cases which are on the borderland of enteric fever as regards their diagnosis, are really due to the bacillus typhi abdominalis. Mr. W. C. C. Pakes, in his article on Widal's reaction,⁴ in discussing the diagnosis, says, "Provisional diagnoses during the course of the disease have not been accepted, unless the physician has been satisfied, after the termination of the case, that it was really enterica or was really not enterica." This excludes a great number of cases, which may be said to be on the borderland of enteric fever. I should like to raise the question, whether some of the so-called aberrant forms of enteric fever, may not rather be due to a septicæmia, similar to enteric fever, but arising from an infection with bacilli, allied to the bacillus typhi abdominalis, or to some organism of the coli group. That an infection arising in the alimentary tract in this way, may give rise to an abdominal condition, closely simulating enteric fever.

In connection with this point, I would bring forward a remark by Dr. Rolleston, in an article on enteric cases, in the Imperial Yeomanry Hospital at Pretoria. He says,⁵ "It is noteworthy that a positive reaction was obtained in only 64·5 per cent. of cases clinically regarded as certainly enteric."

⁴ Widal's Reaction. By W. C. C. Pakes. Guy's Hosp. Rep. Vol. LV.

⁵ The Agglutination Reaction in Typhoid Fever. Memorandum by Dr. H. D. Rolleston. B.M.J., Oct. 12, 1901, p. 1084.

Mr. W. C. C. Pakes, however, gives a much higher percentage,⁶ as also does Gwynn.⁷ In one of the cases, in which I made a bacteriological examination of the heart-blood, kidney, and urine from post-mortem bladder, I found the bacillus para-coli communis in each in pure culture. This patient had died with the clinical symptoms of enteric fever. On post-mortem examination, the appearances were those seen in enteric fever. A positive Widal reaction had been obtained on one occasion.

This, I think, is suggestive of an organism distinct from the bacillus typhi abdominalis being concerned. I have not been able to go into the subject, as it is outside the scope of my thesis, but since my attention has been drawn to it in the course of my work, I have ventured to raise the point.

The subject is one of much difficulty, owing to the want of a proper classification of these allied groups of bacteria, and from the fact that the clinical phases which occur in the disease known as enteric fever, if not grouped together in such a way that "enteric fever" can be diagnosed, are described as "aberrant forms of enteric fever," or "abortive forms of enteric fever," or in some such way.

THE PATHOLOGY OF THE CONDITION.

The presence of the typhoid bacillus in the urine is difficult of explanation. It does not seem to appear in the urine early, for the earliest date on which I found the bacillus was on the twentieth day of the disease. On the other hand, it seems to continue until late in the disease, and in some cases the bacteriuria due to the typhoid bacillus or some allied organism continues far into convalescence (*vide* Case 2).

⁶ Guy's Hosp. Rep. Ibid.

⁷ "Positive results of Widal's Reaction in cases certainly typhoid 99.6 per cent. Of all cases 98.1 per cent." A Study of the Widal Reaction in 265 cases of Typhoid Fever. By Norman B. Gwynn, M.B. The Johns Hopkins Hospital Reports. Vol. viii.

I have been unable to find the bacillus typhi abdominalis in sections of the kidney, taken from post-mortem cases of enteric fever, that I have examined. Neither have I been able to cultivate the bacillus typhi abdominalis from the kidney on any media that I have used. I have, however, cultivated the bacillus para-coli communis from the kidney in one case, and in this case I also found the same organism in the urine taken from the post-mortem bladder. Both of these were in pure culture. On histological examination of the kidney, stained with carbol-thionin blue, I was, however, unable to detect the presence of any organisms in the substance of the kidney, either in the cortex or medulla. Unfortunately, in this case, no examination had been made of the urine during life, and the fact that the bacillus para-coli communis was found also in the heart-blood in pure culture rather lessens the value of this case, as the possibility of the bacilli getting into the blood after death has to be borne in mind.

That the condition is due to a stray bacillus getting into the bladder from the blood through the kidney and multiplying there has been suggested by Dr. Horton Smith,⁸ who discusses the question under the following heads:—

1. Filtration from the blood.—Dismiss this as there is extreme difficulty in finding bacilli in the blood during life, and the blood has been examined bacteriologically, when bacilli have been swarming in the urine, and no bacilli found.

2. Suppuration in kidney.—This is very rare, bacilluria comparatively common.

3. Entrance of a stray bacillus into bladder from blood, through the kidneys.—Dr. Horton Smith shews that of six specimens of urine taken and inoculated with typhoid bacilli, and incubated at 37° C., four shewed general turbidity from growth of the micro-organisms at the end of eighteen hours, while two did not. These latter, however, shewed good growth in forty-eight hours.

If, as he contends, 25 per cent. of patients suffer from bacilluria due to the typhoid bacillus in enteric fever, this explanation of the pathology seems hardly to meet the case. The possibility of some

⁸ Goulstonian Lectures on the Typhoid Bacillus and Typhoid Fever.—*Lancet*, 1900. Part I., p. 821, et seq.

morbid condition in the kidney, allowing the passage of the bacilli through it, is one to be considered.

The pathology of kidney disease is at present obscure, and many points in this connection require to be cleared up. Any case of damage to an organ, however slight, is sufficient to upset its physiological equilibrium. It has been shewn that the staphylococcus pyogenes aureus, injected into the circulation of a rabbit, in most cases, will produce no ill effects upon the healthy heart, but if the cardiac valves have been previously injured, an infective endocarditis will result.⁹ But it has been proved by Biedl and Kraus,¹⁰ that in some cases, bacilli may come through the *normal* kidney, for they showed that micro-organisms which circulate in the blood, can be excreted through the absolutely intact kidneys. To demonstrate this, they chloroformed dogs, fixed a sterilized cannula into the vena jugularis or femoralis, performed laparotomy on the animals, inserted cannulas into the ureters, and examined the urine thus obtained under all the necessary precautions, after having injected the staphylococcus pyogens aureus, the bacillus coli communis, and the bacillus anthracis into the veins. Cultures made from the urine, shewed the micro-organisms which had been injected; examination of the urine was negative as to blood or albumin. They concluded that the normal kidney, through its physiological function, is able to excrete the micro-organisms.

In discussing bacteriuria, Herman Goldenburg¹¹ says that the bacteria enter the bladder, either by *infection* or *auto-infection*. Quoting Ultzmann, he says, that bacteriuria is found in patients with malaria, and in those who work in dissecting rooms, where the infection takes place through the respiratory organs, and that he treated a patient with bacteriuria, complicated by hæmaturia of renal origin, general malaise, and emaciation due to malarial infection, rapid improvement following the administration of quinine and salol. Cases are more frequent in which bacteriuria is due to

⁹ Surgical Pathology and Morbid Anatomy. By Anthony A. Bowlby, F.R.C.S., 4th Edit., p. 49.

¹⁰ Quoted from Herman Goldenburg's article on Bacteriuria. Med. Rec., New York, 1896, p. 228.

¹¹ H. Goldenburg. Bacteriuria. Med. Record, New York, 1896, vol. 1., p. 228.

catheterisation with dirty catheters, and auto-infection takes place from the intestines, either directly through contiguity, or indirectly through absorption by the lymphatics. In connection with infection taking place through the respiratory organs, the following is instructive: Pneumococci were found in the urine in the case of a female patient, aged 60 years, who had an attack of croupous pneumonia. On the seventh day she had pain on micturition, and other symptoms of cystitis. On examination of the urine, Frænkel's pneumococcus was found.¹²

Wreden demonstrated in the laboratory of Professor Nencki, that after a slight artificial traumatism in the rectum of male rabbits, the bacillus coli communis could be found in the urine of the animals. He claimed from this, that bacteria enter the bladder directly through the lymphatics, which connect bladder and rectum. He demonstrated that in rabbits, after a superficial erosion of the rectal epithelium, fatty substances, such as oil and vaseline, which were introduced into the rectum, were found in the urine.

The theory that bacteria enter the bladder in this way seems to be highly probable. Morris¹³ states that "the lymphatics of the bladder pass partly backwards, beneath the peritoneum, to join the rectal lymphatics, or the lymphatics of the uterus and vagina in the female; and partly forward to join the prostatic lymphatics and the lymphatics of the vesiculæ seminales."

Sappey states,¹⁴ that the lymphatics of the bladder have not yet been fully worked out in man, although he has demonstrated their arrangement in the rabbit and dog.

That the lymphatics are enlarged during pregnancy is undoubtedly the case, and admitting that the bacilli gain admittance to the bladder through the lymphatics, one would expect them to get into the urine more easily, during pregnancy, or during the puerperal state.

¹² Pneumococci in the Urine. By G. Munro Smith. Bristol Med. Chir. Journ., 1895, vol. xiii., p. 115.

¹³ A Treatise on Human Anatomy, by various Authors. Edited by Henry Morris, M.A., M.B.

¹⁴ Description et Iconographie des Vaisseaux Lymphatiques Considérés chez L'Homme et les Vertébrés. Par l'h. C. Sappey, p. 124. Vaisseaux lymphatiques de la vessie.

This is borne out by Case 12, in which the patient was a woman aged 30 years, who two or three weeks before being attacked by enteric fever, had been delivered of a child. In her case the bacillus typhi abdominalis was found in the urine on the twentieth day of the disease, when the first examination was made. They were also present on the fifty-first day, when the last bacteriological examination of the urine was made. That they were present before the twentieth day is very probable.

GENERAL CONCLUSIONS OBTAINED FROM THE INVESTIGATION OF THE ABOVE CASES.

1. That there is no definite evidence that the typhoid bacillus comes through the kidney.
2. That sections of the kidney, appropriately stained, shewed no evidence of any bacilli.
3. That the entrance of the bacilli into the bladder through the lymphatics, is much more probable, and that Wreden's experiments are valuable in this direction.
4. That in the majority of cases of enteric fever the bacillus typhi abdominalis is not present in the urine.
5. That when it is present it occurs late rather than early in the disease.
6. That when it is present the urine is generally normal in other respects, or contains only a trace of albumin.
7. That other micro-organisms, such as the bacillus coli communis, and the atypical bacillus typhi abdominalis are sometimes present in the urine in cases of enteric fever, and during the period of convalescence.
8. That as a rule when the bacillus typhi abdominalis is present in the urine there are no local clinical symptoms.
9. That bacteriuria may continue far into convalescence.
10. That the action of urotropin is very effectual in freeing the urine from bacilli.

11. That the bacteriological examination of the urine may be useful in some cases for diagnosis.

12. That the patient should be warned as to the possibility of spreading infection by the urine during convalescence.*

In conclusion, I wish to offer my thanks to the physicians and assistant physicians for their kindness in allowing me to study these conditions of enteric fever, in their respective patients, in the wards of Guy's Hospital.

I wish also to thank Dr. Bryant and Dr. Fawcett for so generously giving me the opportunity of working at the morbid anatomy and bacteriology of the cases on which a post-mortem examination was made. And finally to express my appreciation of the kindness and courtesy of Mr. W. C. C. Pakes, in allowing me the use of the Bacteriological Laboratory, and giving me so many facilities for working, and to thank him for many valuable suggestions in technique.

* In the base hospitals in South Africa it is the rule for the officers of the Royal Army Medical Corps to retain enteric patients for seven weeks after the temperature has reached normal, on account of their spreading infection in this way.

On Enteric Fever.

No. of Case.	Sex.	Age.	CLINICAL FEATURES.									Widal Reaction.	Bacteriological Examination of Urine.	Albumin.	Bacteriological Examination made from Kidney, Spleen or Heart Blood.	REMARKS.
			Fever.	Palpable Spleen.	Rose Spots.	Bronchitis.	Diarrhoea or Constipation.	Delirium.	Hæmorrhage.	Perforation.	Result.					
1	F.	28	Yes	Yes	Yes	Yes	—	—	No	No	Death ...	No examination made ...	None made ...	—	Kidney, sterile ...	—
2	M.	31	Yes	—	Yes	No	Constipation	No	No	No	Recovery ...	Negative ...	Five examinations made. The first, seven months after attack. 1. Seven months after attack. B.C.C. in pure culture. 2. Eight months after attack. Atypical B.C.C. 3. Nine months after attack. B.C.C. 4. Ten months after attack. Atypical B.C.C. 5. Ten months after attack. Sterile (after urotropin).	None ...	—	In this case the urine was examined some months after the attack.
3	F.	9	Yes	Yes	Yes	No	Diarrhoea	No	No	No	Recovery ...	Positive ...	Two examinations made:— 1. On thirty-fifth day of disease (eighth day of relapse) Urine sterile. 2. On thirty-ninth day of disease. Staphylococci.	None ...	—	A relapse occurred in this case.
4	M.	21	Yes	No	No	No	Diarrhoea	No	No	No	Recovery ...	Positive ...	Three examinations made:— 1. First week. Staphylococci. 2. Second week. Staphylococci. 3. Fourth week. Staphylococci.	None ...	—	The history seems to point to this attack being a relapse, after a primary attack of a fortnight's duration.
5	F.	32	Yes	Yes	Yes	Yes	Diarrhoea	No	No	No	Recovery ...	Positive ...	Five examinations made:— 1. On twenty-fifth day. Sterile. 2. On twenty-seventh day. Staphylococci. 3. On thirty-fourth day. Staphylococci. 4. On forty-first day. Sterile. 5. On fifty-fifth day. Cocci.	None ...	—	—
6	M.	27	Yes	No	Yes	Yes	Diarrhoea	No	No	No	Recovery ...	Positive ...	Two examinations made. Both during convalescence:— 1. Staphylococci. 2. Staphylococci.	—	—	Slight attack.
7	M.	29	Yes	Yes	Yes	Yes	Diarrhoea	—	Yes	No	Death ...	Negative ...	Staphylococci. Only one examination made, from post-mortem bladder.	Yes ...	Kidney, sterile; spleen, B.T.A.	Death occurred in what was probably a relapse.
6	F.	4	Yes	No	Yes	No	Diarrhoea	No	—	No	Recovery ...	Positive ...	Five examinations made:— 1. On eighth day. Atypical B.C.C. 2. On fifteenth day. A bacillus, resembling in many respects the bacillus enteritidis of Gärtner. 3. On twentieth day. B.T.A. in pure culture. 4. On thirtieth day. B. proteus vulgaris and staphylococci. 5. On forty-seventh day. B.C.C. and B. proteus vulgaris.	None ...	—	—
9	M.	16	Yes	No	Yes	No	Constipation	No	No	No	Recovery ...	Positive ...	Six examinations made:— 1. On thirteenth day. Staphylococci. 2. On eighteenth day. Staphylococci. 3. On twenty-first day. Staphylococci. 4. On twenty-fourth day. Staphylococci. 5. On twenty-seventh day. Staphylococci. 6. On fortieth day. Cocci, chiefly in pairs.	None ...	—	—
10	M.	11	Yes	Yes	Yes	No	Bowels regular	—	No	No	Recovery ...	Positive ...	Four examinations made:— 1. On twenty-fifth day. Staphylococci. 2. On twenty-ninth day. Staphylococci. 3. On thirty-ninth day. Staphylococci. 4. On forty-seventh day. Staphylococci.	None ...	—	—
11	M.	25	Yes	Yes	No	—	Diarrhoea	No	No	No	Convalescing ...	Positive ...	Three examinations were made:— 1. During interval between primary attack and relapse. Para-typhoid bacillus + Staphylococci. 2. On day of rise of temperature due to relapse. Staphylococci. 3. On eighth day of relapse. Staphylococci + a bacillus of proteus group.	None ...	—	Patient was admitted into hospital during a period of a pyrexia, having had fever, and after a week in hospital getting a relapse.
12	F.	30	Yes	Yes	Yes	Yes	Diarrhoea and Constipation alternating	No	No	No	Convalescing ...	Negative ...	Four examinations were made:— 1. On twentieth day. B.T.A., with staphylococci. 2. On forty-third day. B.T.A. in pure culture. 3. On forty-seventh day. Cocci, and some large bacilli, not B.T.A. 4. On fifty-first day. B.T.A., with a proteus-like organism.	None ...	—	Patient had been delivered of a child one month before. At about the same time a lodger in her house died of enteric fever.
13	M.	19	Yes	Yes	Yes	Yes	—	Yes	Yes	Yes	Death ...	The blood did not react in any dilution; it was examined on two occasions.	One examination only made, from post-mortem bladder:— Para-colon bacillus in pure culture.	—	Kidney and heart blood both showed presence of para-colon bacillus in pure culture.	—
14	M.	34	Yes	Yes	Yes	Yes	Diarrhoea and Constipation alternating	—	Yes	No	Death ...	Not examined ...	One examination only made, from post-mortem bladder:— Urine sterile.	None ...	No satisfactory bacteriological examination could be made of spleen or kidney.	—
15	M.	16	Yes	Yes	Yes	Yes	—	No	No	No	Convalescing ...	Positive ...	Three examinations were made during third and fourth week:— 1. Staphylococci. 2. Staphylococci. 3. Staphylococci.	Slight albumin ...	—	The blood was examined bacteriologically, and was found to be sterile.

B.T.A. = Bacillus typhi abdominalis.

B.C.C. = Bacillus coli communis.



LIST OF CASES.

ABBREVIATIONS.

B.T.A.	=	Bacillus typhi abdominalis.
B.C.C.	=	Bacillus coli communis.
H.D.	=	Hanging drop.
C.M.B.	=	Carbol-methylene blue.
C.F.	=	Carbol-fuchsin.
Gr.-W.	=	Gram-Weigert.
G.F.B.	=	Glucose-formate broth.
F.	=	Female.
M.	=	Male.

NOTE.—In every case when an organism has been obtained in pure culture, this organism has been worked out according to a definite scheme, similar reactions being carried out with each organism, and comparisons afterwards made.

CASE 1.—F., æt. 28 years. Admitted into Miriam Ward under Dr. Washbourn, on July 11th, 1901, for pain in abdomen.

Patient had been ill nine days before admission with severe headaches. She had had one shivering fit, and pain in abdomen. On admission, temperature 105°, pulse 134. A few scattered spots were present on the abdomen, the spleen was palpable, and rhonchi could be heard over both lungs. The motions were of a light yellow colour. The pulse was weak and feeble. Stimulants (strychnine, musk, digitalis, and champagne) were administered. The pulse, however, became more feeble, she became cyanosed and died seven days after admission from heart failure. The blood was not examined for Widal's reaction.

A post-mortem examination was made six and a-half hours after death. The right lung was œdematous. Three feet from the cæcum was a small ulcer perforating the mucous membrane of the small intestine, and affecting the muscular coat. Below this were numerous raised infiltrating Peyer's patches, in a few of which ulceration had occurred; in the majority, however, there was no ulceration. There was no perforation of the intestinal wall. The pancreas was tough; the spleen large and tough. Histological examination of the kidney shewed the absence of any organisms.

Bacteriological Examination of the Kidney.

Broth, 37° C. Eighteen hours; four days, nil.

Agar, 37° C. Eighteen hours; four days, nil.

G.F.B. (anaerobically) 37° C. Eighteen hours, nil; four days, nil.

Direct film. C.M.B. Nil.

Gr.-W. Nil.

The kidney was sterile.

CASE 2.—M., æt. 31 years. This case is one in which a definite attack of enteric fever, with pyrexia, severe headache, and extreme prostration and feeble pulse, and rose-red spots, occurred seven months before the first examination of the urine was made. No Widal's reaction was tried at the time,

but the test being performed nine months, after the temperature fell to normal, gave a negative reaction (50 per cent. = O. 5 per cent. = O. 0.5 per cent. = 0). When, however, the serum was examined, as in Gruber's reaction, using a broth culture made from a gelatine culture of an organism, obtained from the urine of the same case (the bacillus para-coli communis), it was found to cause clumping of the bacilli.

The notes recording this are as follows:—

Blood examination for Gruber's reaction—

50 per cent. commenced clumping in five minutes, fully clumped in twenty-five minutes.

50 per cent. slight signs of clumping in twelve minutes, fully clumped in thirty minutes.

0.5 per cent. not clumped in thirty minutes.

50 per cent. = +. 5 per cent. = +. 0.5 per cent. = O.

There were no complications in this case. Five examinations of the urine were made. Four of these were made before, and one after the administration of urotropin. The quantity of urotropin given was sixty grains, in six doses of ten grains each, administered three times a day over a period of two days. After this the urine was found to be quite sterile. There was no albumin at any time. The first examination of the urine was made seven months after the temperature became normal, the final one three months after this.

SPECIMEN 1.—Urine.

Description.—A bacillus.

Motility.—In dextrose broth, after six hours' growth, very slightly motile.

Staining.—Stains with C.M.B. Decolorised by Gram-Weigert.

Broth (37° twenty-four hours).—Turbidity, white sediment; two days, very slight trace of indol.

Peptone water (37° twenty-four hours).—Slight turbidity.

Formate broth (37° twenty-four hours).—Much gas formation, slight turbidity.

Dextrose broth (37° twenty-four hours).—Much gas formation, turbidity.

Lactose broth (37° twenty-four hours).—Gas formation, turbidity.

Saccharose broth (37° twenty-four hours).—Much gas formation, turbidity.

Glycerine broth (37° twenty-four hours).—Much gas formation, turbidity.

Nitrate broth (37° twenty-four hours).—No gas; turbidity. Red colour with meta-phenylene diamine = nitrites.

Lead broth (37° twenty-four hours).—

Gelatin stab (20° twenty-four hours).—White growth down stab; no spreading on surface; gas formation; no liquefaction.

Gelatin streak (20° twenty-four hours).—Well marked, raised, moist-looking, white vigorous growth, no liquefaction.

Gelatin shake (20° twenty-four hours).—Slight turbidity, much gas, no liquefaction.

Gelatin plates (20° two days).—Moist looking, small, white colonies, no liquefaction.

Agar streak (37° twenty-four hours).—Well marked, raised moist looking growth, gas formation.

Agar plates (37° thirty-six hours).—Large white moist-looking growths; raised; large gas bubbles; very vigorous growth.

Blood-serum (37° twenty-four hours).—Vigorous, moist-looking, white, raised growth.

Litmus milk (37° twenty-four hours).—Acidity, milk entirely clotted.

Potato (37° twenty-four hours).—Raised, yellowish, dirty-looking, vigorous growth.

Anærobic growth (37° twenty-four hours).—Gas, slight turbidity, slight sediment.

Laevulose peptone (twenty-four hours). Much gas formation. Turbidity.

= *Bacillus Coli Communis*.

SPECIMEN 2.—*Urine*.

Description.—A bacillus.

Motility.—Very slightly motile (two days agar).

Staining.—With C.M.B. Decolorised by Gram-Weigert.

Pleomorphism.—Long and short bacilli.

Broth (37° twenty-four hours).—Turbidity, flocculence, sediment; four days, do., no indol.

Peptone water (37° twenty-four hours).—Slight turbidity, flocculence, sediment; four days, do.; five days, no indol.

Formate broth (37° twenty-four hours).—Gas formation, slight turbidity; four days, slight seum, no gas.

Dextrose broth (37° twenty-four hours).—Gas formation, slight turbidity; four days, no gas, acid.

Lactose broth (37° twenty-four hours).—Gas formation, slight turbidity; four days, no gas, acid.

Saccharose broth (37° twenty-four hours).—Marked gas formation, slight turbidity; four days, no gas, acid, sediment.

Glycerine broth (37° twenty-four hours).—Gas formation, slight turbidity; four days, no gas, acid.

Nitrate broth (37° twenty-four hours).—Turbidity, white sediment; two days, red colour with metaphenylene diamine = Nitrites.

Lead broth (37° twenty-four hours).—Turbidity; four days, very slight H_2S .

Gelatin stab (20° twenty-four hours).—Whitish growth along stab, gas; four days, no liquefaction; twenty-five days, gas, no liquefaction.

Gelatin streak (20° twenty-four hours).—Raised, narrow, whitish growth; four days, increased, no liquefaction; twenty-five days, no liquefaction.

Gelatin shake (20° twenty-four hours).—Gas formation; four days, dotted colonies on surface, slight turbidity; twenty-five days, no liquefaction.

Agar streak (37° twenty-four hours).—Well-marked, raised, moist-looking growth, gas formation; four days, do.

Agar plates (37° three days).—Large white colonies; gas formation.

Blood-serum (37° twenty-four hours).—Spreading, white, dry, growth; four days, do.

Litmus milk (37° twenty-four hours).—Marked acidity, marked gas, some clotting; two days, marked clotting; four days, decolourised.

Potato (37° twenty-four hours).—Raised, white, dry growth; four days, raised, marked, yellowish-brown growth.

Anærobic growth (37° twenty-four hours).—Gas formation; four days, gas formation.

Laevulose broth 37° (twenty-four hours).—Marked gas formation, turbidity; four days, no gas, sediment.

= Atypical *Bacillus Coli Communis* (atypical because of no indol formation).

SPECIMEN 3.—*Urine*. Acid, no albumen.

Description.—Bacilli, rather short and thick.

Motility.—? Slightly motile, agar. Definitely slightly motile (Dextrose broth six hours.)

Staining with carbol methylene blue. Decolorised by Gram-Weigert.

Broth (37° twenty-four hours).—Turbid, white sediment, flocculi, no gas; four days, trace of indol; five days, trace of indol.

Peptone water (37° twenty-four hours).—Turbid, white deposit; thirteen days, no indol.

Formate broth (37° twenty-four hours).—Turbid, flocculent deposit; four days, turbid, no gas, slight sediment.

Dextrose broth (37° two days).—Much gas, acid.

Lactose broth (37° twenty-four hours).—Turbid, acid, much gas; four days, no gas.

Saccharose broth (37° twenty-four hours).—Turbid, acid, plenty of gas; four days, turbid, acid, no gas.

Glycerine broth (37° twenty-four hours).—Turbid, acid, no gas; four days, turbid, acid, no gas.

Nitrate broth (37° twenty-four hours).—Turbid, sediment, no gas; four days, good nitrites (with metaphenylene diamine).

Lead broth (37° twenty-four hours).—Slight H₂S.; four days, good H₂S.; thirteen days, good H₂S.

Gelatin stab (20° twenty-four hours).—Small dotted colonies down stab, growth on surface, no liquefaction; thirteen days, no gas, no liquefaction.

Gelatin streak (20° twenty-four hours).—Good growth, raised, moist-looking white; thirteen days, no gas, no liquefaction.

Gelatin shake (20° twenty-four hours).—Good gas bubbles all through medium, slight turbidity; thirteen days, gas at bottom only.

Agar streak (37° twenty-four hours).—Good growth, raised, white, vigorous; gas formation in agar. Four days, increased.

Agar plates (37° twenty-four hours).—White colonies, gas; seven days, large, yellowish white, moist-looking colonies.

Blood-serum (37° twenty-four hours).—Raised, very thick, yellowish white growth; four days, increased; thirteen days, ditto.

Litmus milk (37° twenty-four hours).—Well-marked acidity, no clotting, seum; four days, completely clotted, decolorized; thirteen days, do.

Potato (37° twenty-four hours).—Raised, yellowish-white, moist-looking growth; four days, yellowish-brown, moist; thirteen days, very moist-looking, dirty-white growth.

Anaerobic growth (37° twenty-four hours).—Turbid, good gas; four days, good gas.

= *Bacillus Coli Communis*.

SPECIMEN 4.—*Urine* (Acid. No albumin).

Description.—A short oval bacillus.

Motility.—Very slight motility (Dextrose broth).

Staining.—Faintly with C.M.B. Slightly with C.F. Decolourised by Gram-Weigert.

Pleomorphism.—Some larger forms.

Broth (37° twenty-four hours).—Turbid, white deposit, fair gas; two days, slight trace of gas; five days, no indol.

Formate broth (37° twenty-four hours).—Abundant gas; two days, alkaline, no gas; four days, alkaline.

Dextrose broth (37° twenty-four hours).—Abundant gas; two days, acid, no gas; four days, acid, no gas.

Lactose broth (37° twenty-four hours).—Abundant gas; two days, acid, no gas; four days, acid, no gas.

Saccharose broth (37° twenty-four hours).—Abundant gas; two days, acid, good gas; four days, acid, no gas.

Glycerine broth (37° twenty-four hours).—Very good gas; two days, acid, no gas; four days, acid, no gas.

Nitrate broth (37° twenty-four hours).—Abundant gas, good nitrites with metaphenylene diamine.

Lead broth (37° twenty-four hours).—Turbid, no H_2S ; four days, good H_2S .

Gelatin stab (20° twenty-four hours).—Slight growth, no gas, no liquefaction.

Gelatin streak (20° twenty-four hours).—Fair growth, no gas, no liquefaction.

Gelatin shake (20° twenty-four hours).—Good gas bubbles, throughout medium; no liquefaction.

Agar streak (37° twenty-four hours).—Vigorous, white, raised, growth, some gas bubbles; two days, increased; four days, increased.

Agar plates (37° twenty-four hours).—White colonies; six days, large white colonies.

Blood-serum (37° twenty-four hours).—Dry, wrinkled-looking growth; four days, increased.

Litmus milk (37° twenty-four hours).—Acid, entirely clotted; two days, do. decolourised; four days, do.

Potato (37° twenty-four hours).—Dry, yellowish, raised dotted growth, over whole surface; four days, growth much raised.

Anærobic growth (37° twenty-four hours).—Turbid, abundant gas; two days, good gas; four days, good gas.

= Atypical *Bacillus Coli Communis*.

There is no Indol Reaction, differing thus from the typical *Bacillus Coli Communis*.

SPECIMEN 5.—*Urine*. No albumin. Acid.

Examined after the administration of six ten-grain doses of urotropin given three times a day for two days, and found to be sterile.

Broth 37° twenty-four hours, nil; two days, nil; four days, nil.

Glucose formate broth (anærobically) 37° twenty-four hours, nil; two days, nil; four days, nil.

CASE 3.—F. æt. 9 years. Admitted into Mary Ward under Dr. Taylor, on July 3rd, 1901, for headache and fever. Twelve days before admission she had a sore throat and headache. The throat improved but the headache continued, and she complained of pain in legs. She became very weak. The motions were watery and yellow. She has become thinner, and has great thirst. She has had fever five days. Condition on admission: Pulse 124, temperature 102.6°, respiration 28, urine 1024, acid; no albumin. Spleen not palpable. The temperature became normal on the fifth day after admission, and continued normal until the seventeenth, when it rose to 103.2°. (Interval = fourteen days). On the eighteenth day Widal's reaction was present. On the twenty-second, spots appeared on the abdomen, this being the

sixth day after the temperature rose; the spleen became palpable; on the twenty-third day more spots appeared. The temperature rose to 104·6°, and patient was sponged. On the twenty-fifth day, being the thirty-fifth day of the disease, including relapse interval, the urine was examined bacteriologically, and also on the thirty-ninth day of the disease.

July 28th. There are over thirty spots to-day.

July 30th. Some of the spots have faded, but there are still a large number. Bowels constipated. Glycerine enema.

August 1st. Most of the spots have faded. Temperature keeps below normal.

August 5th. Urine 1020, faintly acid. Albumin, blood and pus present.

Urotropin	...	...	gr. v.
Ammon. Beng...	...	...	gr. v.
Tinct." Hyoscyam.	...	...	℥ x.
Sp. Chlorof.	...	...	℥ v.
Inf. Uvæ Ursi ad	...	...	3 ss. bis die.

The urine unfortunately was not examined bacteriologically at this time.

August 8th. There are no spots. Temperature normal. The urine became normal after the exhibition of urotropin. Glycerine enema.

August 10th. Patient is going on well; temperature has not risen above 99° for nine days. Pulse 60, respiration 20. There are no spots.

August 12th. Condition is improving. The bowels are rather constipated. The urine is normal. Temperature 96·4°—98·6°. There are no spots.

August 21st. On full diet. Gets up after tea.

August 24th. Patient discharged.

July 12th. Widal reaction 50 per cent. = + 5 per cent. = + 0·5 per cent. = +.

SPECIMEN 1.

G.F.B. 37° (anærobically). Two days, nil.

Gelatine plate. Nil.

Two broth tubes added to flask at 37°. Twelve hours, nil; three days, nil.
= urine sterile.

SPECIMEN 2.

Hanging drop. Nil.

G.F.B., 37°. Twenty-four hours; turbidity.

Broth, 37°. Twenty-four hours; turbidity.

Agar plates, 37°. Twenty-four hours; a few white colonies.

C.M.B. Staphylococci only.

Gram-Weigert. Staphylococci present.

Staphylococci only.

CASE 4.—M., æt. 21 years. Admitted into Philip Ward under Dr. Taylor, on July 26th, for diarrhœa.

For three weeks before admission he suffered from headache. He did his work nevertheless. For seven days before admission patient was feeling very weak, and for three days had suffered with diarrhœa.

On admission, he was pale and drowsy, with signs of much weakness, with a foul tongue and breath. The abdomen was full, but the spleen could not be felt. There was an apical systolic bruit. There were no spots. The urine was normal. There was diarrhœa. The blood gave the Widal reaction.

The pyrexia continued for rather over three weeks and then dropped to normal, the patient being eventually discharged convalescent.

Three examinations of the urine were made, on each occasion staphylococci only were found.

July 27th. Widal's reaction, 50 per cent. = +. 5 per cent. = +. 0.5 per cent. = + O.

SPECIMEN 1.—*Urine*. No albumin.

H.D. Urine, nil.

Broth, 37°. Twenty-four hours; cocci in pairs.

G.F.B., 27°. Twenty-four hours; no gas; slight turbidity (anaerobically).

Agar plates, 37°. Twenty-four hours; large white colonies.

C.M.B. Staphylococci only.

Planted agar tube from agar plate. Twenty-four hours.

H.D. Cocci; C.M.B., staphylococci.

Gram-Weigert. Staphylococci (stain well).

Staphylococci only present.

SPECIMEN 2.

H.D. Urine, nil.

Broth, 37°. Twenty-four hours, turbid; no gas.

G.F.B., 37°. Twenty-four hours; no gas; cloudy; slight white sediment.

H.D., cocci only.

Agar plate, 37°. Twenty-four hours; a large number of large and small white colonies. G.M.B. Staphylococci only.

Staphylococci only present.

SPECIMEN 3.—*Urine*. No albumin.

H.D. Urine, nil.

Broth, 37°. Twenty-four hours; turbid; no gas; H.D., cocci only.

G.F.B., 37°. Twenty-four hours; slightly turbid; no gas.

Agar plate, 37°. Twenty-four hours; dotted white colonies.

C.M.B. Staphylococci only.

Staphylococci only present.

CASE 5.—F., æt. 32 years, married. Admitted into Miriam Ward under Dr. Washbourn, for continued fever and diarrhœa, on August 15th, 1901. Thirteen days before admission she was attacked with severe pains in the abdomen, and vomiting. On the day following diarrhœa set in, and has continued since. She has also suffered from headache, pain in the back and limbs, and weakness. On August 12th a specimen of her blood showed a marked Widal reaction when examined at the Jenner Institute. On admission: Temperature 103.2°, pulse 124, respiration 35. Tongue furred, face flushed, abdomen full, with a few faint rose-coloured spots. The spleen is not palpable. Pulse rapid, small, soft, regular. Heart-sounds normal. Many non-consonating râles to be heard in the chest. The pulse became rather feeble, and she was ordered brandy. On August 17th the spleen could be felt. The pulse is still feeble. On August 18th a few fresh spots were noticed on the abdomen. Diarrhœa continued, and *Mist. Opii Acida* was ordered.

The diarrhœa ceased, and patient gradually improved, and was discharged convalescent on September 27th. Bacteriological examinations of the urine were made on five occasions. On the twenty-fifth, twenty-seventh, thirty-fourth, forty-first and fifty-fifth day of the disease. Twice it was found to be quite sterile. On three occasions staphylococci only were found.

SPECIMEN 1.—Twenty-fifth day.

H.D., urine, nil.

Broth, 37° twenty-fours, nil. Four days, nil.

G.F.B. (anaerobic growth) 37° twenty-four hours, nil. Two days, nil. Four days, nil.

SPECIMEN 2.—Twenty-seventh day.

Broth, 37° twenty-four hours, nil. Turbidity.

Glucose formate broth 37° twenty-four hours, nil. Three days, turbidity.

Agar slope, twenty-four hours, nil.

C.M.B., staphylococci only present.

SPECIMEN 3.—Thirty-fourth day.

H.D., nil.

Broth, 37°, twenty-four hours, nil. Two days, white sediment, clear fluid.

G.F.B., 37°, twenty-four hours, nil. Two days, turbid.

Agar plate, 37°, twenty-four hours, nil. Two days, white colonies.

Planted agar plates from agar. Small round white and yellow colonies.

Staphylococci only.

SPECIMEN 4.—Forty-first day.

H.D., urine, nil.

Broth, 37°, twenty-four hours, nil. Two days, nil.

G.F.B., 37°, twenty-four hours, nil. Two days, nil.

Agar plates, twenty-four hours, nil.

The urine is sterile.

SPECIMEN 5.—Fifty-fifth day. Urine. No albumin.

H.D., urine, nil.

G.F.B., 37°, twenty-four hours. Turbid.

Broth, 37°, twenty-four hours. H.D. cocci.

Agar plate, 37°, twenty-four hours. White colonies. H.D. cocci.

Planted agar tube from agar plate. Twenty-four hours, very sticky growth of small white dotted colonies; vigorous growth. H.D. nil. C.M.B. nil. Planted a broth tube from agar tube as this so sticky that no organisms would adhere to cover slip. Planted gelatin stab 20°, three days. No liquefaction. C.M.B. cocci only. H.D. cocci only, chiefly in pairs. Planted broth 37°, seven days. H.D. cocci only.

CASE 6.—M., æt. 27 years. Admitted into Stephen Ward under care of Dr. Pitt, on August 15th, 1901, for pain in the head and abdomen. For three weeks previously he had suffered from pain in the head and the back of neck. He was weak, and suffered from giddiness.

On admission, temperature 103·2°, pulse 72. There is diarrhœa. There are two or three rose-coloured spots on abdomen which disappear on pressure. The tongue and breath are foul. The spleen cannot be felt. There are a few râles and rhonchi to be heard in the chest.

August 16th. More spots appearing.

August 17th. Temperature 103·6°. Patient gradually improved and was discharged convalescent on September 12th.

A bacteriological examination of the urine was made on two occasions. On each occasion staphylococci only were found.

August 17th. Widal reaction.

50 per cent. = + 5 per cent. = + 0·5 per cent. = + 4.

SPECIMEN 1.

H.D. Urine, nil.

Broth, 37°.

G.F.B., 37°. Twenty-four hours; H.D., cocci only, in short chains.

Planted agar from G.F.B. Twenty-four hours; small white and yellow colonies; cocci only.

Centrifugalized some (original) urine; planted broth; twenty-four hours; white sediment; staphylococci only.

Planted three gelatine plates from broth; twenty-four hours, nil; three days; staphylococci only.

Staphylococci only present.

SPECIMEN 2.

H.D. Urine, nil.

G.F.B., 27°. Twenty-four hours; slight turbidity; sediment; no gas; two days, do.

Broth, 37°. Twenty-four hours; turbidity; white sediment; two days, do.

Agar plate, 37°. Twenty-four hours; numerous small white colonies; H.D., cocci.

Stained G.F.B. and agar plate growths with C.M.B. = staphylococci only.

CASE 7.—M., æt. 29 years. Admitted into John Ward under Dr. Washbourn on August 15th, 1901, for pyrexia and albuminuria.

Seven weeks ago he had severe diarrhoea, which lasted about a month. The motions were green. He had also slight headache. He was kept on milk and soda water for a fortnight, and after that on custards. He was told that he had gastritis. He remained in bed for three weeks, and, after that he did no work for three weeks as he felt very weak. A week ago he caught a chill and went to see his doctor, who took his temperature and sent him to bed. He was told he had a relapse, and he was sent to Guy's Hospital after having been in bed again for a week, during which he felt weak, but was otherwise feeling well.

On admission, the pulse was 108, temperature 100·2°. A few raised rose-red spots which fade on pressure are present on the abdomen. The heart is normal. Râles and rhonchi can be heard in the chest. The abdomen is not distended. The spleen is palpable. The pharynx is injected and sore. Tonsils swollen and covered with mucus. No diarrhoea. Urine 1015; Neutral; albumin, phosphates, and urates present. The blood was negative to the Widal reaction.

August 16th. The spots have disappeared. No suspicious new ones have appeared. Stools liquid, brown, not offensive. Diet, milk and soda water, brandy.

August 17th. A small quantity of blood in motions this morning.

August 18th. Temperature 103°, sponged.

August 19th. Pulse 120, regular, weak. No definite spots. Spleen palpable.

August 23. Sponging does not reduce temperature. Quinine, grs. xx. This had apparently a marked effect. A trace of blood in motions. The blood is still negative to Widal's reaction.

August 26th. Temperature 104°. Great hæmorrhages from bowels this morning, and he was much paler. Morphia was administered, and later lead

and opium, and tannic acid, ice compresses to abdomen. These had, however, no effect, and patient died.

Post-mortem examination.—Spleen much enlarged. Ulceration of small and large intestine. Iron found free in liver.

August 16th. Widal reaction.

50 per cent. = 0. 5 per cent. = 0. 0·5 per cent. = 0.

Spleen.

Description.—Short bacilli.

Motility.—Fair motility.

Staining.—Fairly well with C.M.B. Decolorised by Gram-Weigert.

Broth.—(37° twenty-four hours).—Turbidity, no gas; four days, no indol.

Peptone water (37° twenty-four hours).—Turbidity, no gas; four days, do.; five days, no indol.

Formate broth (37° twenty-four hours).—No gas; four days, no gas.

Dextrose broth (37° twenty-four hours).—Acid, turbid, no gas; four days, do.

Laetose broth (37° twenty-four hours).—No gas; four days, do.

Saccharose broth (37° twenty-four hours).—No gas; four days, do.

Glycerine broth (37° twenty-four hours).—No gas; four days, do.

Nitrate broth (37° twenty-four hours).—Turbid, sediment, no gas; two days, abundant nitrites (with metaphenylene diamine).

Lead broth (37° twenty-four hours).—Turbidity, slight H₂S.; four days, do.

Gelatin stab (20° twenty-four hours).—Growth along stab; four days, do., some slightly spreading growth on surface.

Gelatin streak (20° twenty-four hours).—Slight greyish white growth; four days, do.

Gelatin shake (20° twenty-four hours).—Turbid, no gas; four days, no gas.

Agar streak (37° twenty-four hours).—Slight, white growth; four days, increased slightly but not vigorous.

Blood-serum (37° twenty-four hours).—Slight white growth; four days, do.

Litmus milk (37° twenty-four hours).—Nil; two days, distinctly acid, no clotting; four days do., no clotting.

Potato (37° twenty-four hours).—Moist-looking growth; four days, do., a transparent film.

Anaerobic growth (37° twenty-four hours).—Turbid, no gas; four days, no gas, slightly turbid.

Griber's reaction.—50 per cent. = +. 5 per cent. = ++. 0·5 per cent. = +.

NOTE.—Experiment done with a twenty-four hours' broth culture grown from gelatine, using a serum that had previously reacted perfectly with a known bacillus typhi abdominalis.

= Bacillus Typhi Abdominalis.

Baeteriological examination of urine from post-mortem bladder.

In the examination of the urine from the post-mortem bladder, the surface of the bladder was sterilized with a searing iron, and an incision made with a sterile knife through the bladder wall. Some urine was now drawn up by means of a sterilized pipette, and transferred to a sterilized flask.

Broth, 37°. Twenty-four hours; turbid; floeculent.

G.F.B., 37°. Twenty-four hours; turbid; floeculent.

Agar, 37°. Twenty-four hours; small, white, colonies dotted over the surface.

Staphylococci only were found in these.

Bacteriological examination of kidney.

Agar, sloped, 37°. Twenty-four hours, nil; two days, nil; four days, nil.

Broth, 37°. Twenty-four hours, nil; two days, nil; four days, nil.

G.F.B., 37°. Twenty-four hours, nil; two days, nil; four days, nil.

The kidney is sterile.

Histological examination of a section of the kidney stained with carbol thionin blue shewed the absence of any organisms.

CASE 8.—F., æt. 3 years and 10 months. Admitted under the care of Dr. Taylor, into Mary Ward, on August 26th, for diarrhœa. Four days ago she was taken ill with diarrhœa. There has been no vomiting. She has been drowsy, and has not appeared to be in pain. On admission, temperature 103°, pulse, 120, respiration 32. Heart-sounds normal. Lungs normal. The abdomen is full and there are some raised spots upon it. There is diarrhœa.

August 27th. Temperature 104.4°. More spots have appeared on the abdomen.

August 29th. Temperature 103.6. The blood gives a well-marked Widal reaction. 50 per cent. = O. 5 per cent. = +. 0.5 per cent. = O.

September 2nd. Temperature 104°. Abdomen tense and rather full.

September 5th. Temperature 102.8°. Diarrhœa still continues. Abdomen less distended. Spleen not palpable.

September 8th. Diarrhœa less.

September 14th. Diarrhœa almost disappeared. Temperature 101.4°.

September 18th. Patient much improved. Spleen not palpable.

October 1st. Bowels constipated. Enemata. Temperature 99°

October 3rd. Farinaceous diet.

Bacteriological examinations of the urine were made on five occasions, on the eighth, thirteenth, twentieth, thirtieth, and forty-seventh days of the disease respectively. The first examination shewed an atypical colon bacillus to be present in pure culture. The second examination shewed the presence in pure culture of a bacillus, similar to the bacillus enteritidis of Gärtner, but differing from it in that no alkalinity of milk was produced. The third examination shewed the presence of the bacillus typhi abdominalis in pure culture. In the fourth examination staphylococci were found, and a bacillus which was probably proteus vulgaris, as it caused liquefaction of gelatine among other reactions, thus differentiating it at once from the typhoid and coli groups. The fifth examination shewed the presence of the bacillus coli communis and the bacillus proteus vulgaris.

SPECIMEN 1.—Urine. No albumin. Catheterized, with aseptic precautions.

Description.—A bacillus.

Motility.—Fair motility.

Staining with C.M.B. Decolorised by Gram-Weigert.

Broth (37° twenty-four hours).—Turbidity, no gas; two days, turbidity, sediment, no gas; six days, good indol.

Peptone water (37° twenty-four hours).—Turbidity; six days, good indol.

Formate broth (37° twenty-four hours).—Marked gas formation; two days, no gas, no colour change; six days do.

Dextrose broth (37° twenty-four hours).—Good gas formation, acid; two days, no gas, acid; six days, do.

Lactose broth (37° twenty-four hours).—Good gas formation, acid; two days, no gas; six days, acid.

Saccharose broth (37° twenty-four hours).—No gas, no colour change, slightly turbid.

Glycerine broth (37° twenty-four hours).—Nil; two days, good gas formation, slightly acid; six days, no gas, acid.

Nitrate broth (37° twenty-four hours).—Marked turbidity, gas, good nitrites (with metaphenylene-diamine).

Lead broth (37° twenty-four hours).—Marked turbidity, no H_2S ; two days, slight H_2S ; six days, do.

Gelatin stab (20° twenty-four hours).—Slight growth along stab, no gas; two days do.; six days, no liquefaction, growth on surface.

Gelatin streak (20° twenty-four hours).—Slight growth; two days, transparent growth, irregular edges, no liquefaction; six days do.

Gelatin shake (20° twenty-four hours).—Turbidity, some gas bubbles, no liquefaction; two days do.; six days do., cloudy.

Agar streak (37° twenty-four hours).—Vigorous, spreading greyish white growth; six days do.

Blood-serum (37° twenty-four hours).—Well marked, raised white growth; two days do.; six days do.

Litmus milk (37° twenty-four hours).—Marked acidity, no clotting; six days, no clotting; twelve days, no clotting.

Potato (37° twenty-four hours).—Very slight whitish growth; two days do.; six days, raised yellowish white growth.

Anærobic growth (37° twenty-four hours).—Turbidity, marked gas production.

= Atypical bacillus coli communis.

Differs from bacillus coli communis in that it does not clot milk.

SPECIMEN 2.—Urine.

Description.—A bacillus.

Motility.—Very motile.

Staining.—Stains fairly with C.M.B. Deecolourised by Gram-Weigert.

Pleomorphism.—Longer and shorter forms.

Broth (37° twenty-four hours).—Marked turbidity, white deposit on sides, sediment, no gas; two days, do.; four days, no indol.

Peptone water (37° twenty-four hours).—Slight turbidity, sediment, no gas; two days, do.; four days, do.; ten days, no indol.

Formate broth (37° twenty-four hours).—Slight turbidity, sediment, marked gas formation, no acidity; two days, no gas, alkalinity; four days, do.

Dextrose broth (37° twenty-four hours).—Sediment, acidity, marked gas formation; two days, no gas; four days, do.

Lactose broth (37° twenty-four hours).—Sediment, acidity, gas formation; two days, no gas; four days, do.

Saccharose broth (37° twenty-four hours).—No gas, no change; two days, slight turbidity; four days, do.

Glycerine broth (37° twenty-four hours).—Distinctly acid, no gas; two days, do.; four days, do.

Nitrate broth (37° twenty-four hours).—Turbidity, sediment, no gas; two days, do., good nitrites with metaphenylene diamine.

Lead broth (37° twenty-four hours).—Turbidity, very slight H_2S ; two days, fair H_2S ; four days, good H_2S .

Gelatin stab (20° twenty-four hours).—Slight growth along stab none on surface; four days' growth spreading on surface.

Gelatin streak (20° twenty-four hours).—Semi-translucent growth with irregular edge, no liquefaction; two days, do.; four days, good growth.

Gelatin shake (20° twenty-four hours).—Slight turbidity, good gas bubbles, no liquefaction; two days, do.; note that gas bubbles are not within half an inch of surface; four days, growth on surface.

Agar streak (37° twenty-four hours).—Vigorous, yellowish white growth; two days, do.; four days, spreading growth on surface.

Agar plates (37° twenty-four hours).—Whitish colonies.

Blood-serum (37° twenty-four hours).—Raised, yellowish white growth two days, do.; four days, do.

Litmus milk (37° twenty-four hours).—Marked acidity, no clotting; four days, no clotting; ten days, no clotting; thirty days, no clotting.

Potato (37° twenty-four hours).—Very slight growth; two days, do.; four days, thick raised growth.

Anaerobic growth (37° twenty-four hours).—Turbidity, very marked gas formation, two days, do.; four days, still some gas; ten days, no gas, sediment.

This bacillus is similar to the bacillus enteritidis of Gärtner but differs from it in that no alkalinity of milk is produced.

SPECIMEN 3.—*Urine*.

Description.—A short bacillus, slightly motile (agar).

Staining.—Stains faintly with C.M.B., well with C.F., decolorised with Gram-Weigert.

Pleomorphism.—Longer and shorter forms.

Broth (37° twenty-four hours).—Slightly turbid, no gas; three days do; four days, no indol.

Peptone water (37° twenty-four hours).—No gas; three days, nil; six days, no indol.

Formate broth (37° twenty-four hours).—Very slightly turbid, no gas; three days, no gas, slightly alkaline; eight days do.

Dextrose broth (37° twenty-four hours).—Acid, no gas, slightly turbid three days do.

Lactose broth (37° twenty-four hours).—Nil; two days, slightly red, no gas; six days, acid, no gas.

Saccharose broth (37° twenty-four hours).—Nil, no gas; three days, nil six days, nil.

Glycerine broth (37° twenty-four hours).—No gas; three days, nil; six days, nil.

Nitrate broth (37° twenty-four hours).—Slight nitrites (with metaphenylene diamine).

Lead broth (37° twenty-four hours).—No H₂S; three days, no H₂S; six days, no H₂S; thirteen days, no H₂S; twenty-one days, no H₂S.

Gelatin stab (20° twenty-four hours).—Nil, no gas; six days, very slight growth down stab; ten days, no gas, no liquefaction.

Gelatin streak (20° twenty-four hours).—Very slight growth; six days do., no gas; ten days, no gas; no liquefaction.

Gelatin shake (37° twenty-four hours).—No gas, nil; six days, nil, no gas; ten days, no gas, no liquefaction.

Agar streak (37° twenty-four hours).—Slight white growth, dotted colonies; six days, do.

Blood-serum (37° twenty-four hours).—Very slight growth, dotted colonies; three days, do; six days, do.

Litmus milk (37° twenty-four hours).—Acid, no clotting; six days, do.; eight days, no clotting; twenty-one days, no clotting.

Potato (37° twenty-four hours).—Nil; six days, nil; eight days, very slight growth.

Ancrobie growth (37° twenty-four hours).—Slight turbidity, no gas; three days, do; six days, clear, sediment.

= *Bacillus typhi abdominalis*.

SPECIMEN 4.—*Urine*. No albumin.

20th September, 1901. H.D. *Urine*, nil.

Glucose formate broth, 37°. Twenty-four hours; turbid, gas, white flocculi.

Broth, 37°. Twenty-four hours; turbid, no gas, flocculi.

Agar plate, 37°. Twenty-four hours; a few white colonies, and an uniform growth spreading over plate.

23rd September, 1901. C.M.B. agar. Staphylococci only.

C.F. broth. Bacilli, many well stained. Made three agar plates from broth.

24th September, 1901. Rather short bacilli, very motile, stained with C.M.B.

Planted agar tube, 37°. Twenty-four hours; growth simulates that of proteus.

Formate broth, 37°. Gas, slight acidity.

Gelatin slope, 20°. Twenty-four hours; pure culture; liquefaction of gelatin; this excludes the coli and typhoid groups. Probably proteus vulgaris. The organism was not further worked out.

SPECIMEN 5.—*Urine*.

Description.—Short thick bacilli.

Motility.—Slightly motile.

Staining.—Fairly stained with C.M.B., well stained with C.F., decolorised with Gram-Weigert.

Pleomorphism.—Short oval bacilli, some longer forms.

Broth (37° twenty-four hours).—Turbid, sediment, no gas; three days, do.; five days, good indol.

Peptone water (37° twenty-four hours).—Turbid, no gas; two days, turbid, no gas.

Formate broth (37° twenty-four hours).—Turbid, gas formation, not acid; two days, no gas; four days, turbid, alkaline; no gas.

Dextrose broth (37° six hours).—Acid, turbid, abundant gas; twenty-four hours, no gas.

Lactose broth (37° twenty-four hours).—Acid, gas; two days, acid, no gas; three days, acid, fair gas; four days, acid, no gas.

Saccharose broth (37° twenty-four hours).—Slightly acid, no gas; two days, acid, very slight gas; three days, acid, very slight gas; four days, do.

Glycerine broth (37° twenty-four hours).—Turbid, no gas; two days, fair gas; three days, good gas; four days, acid, good gas.

Nitrate broth (37° twenty-four hours).—Turbid, good nitrites (with meta-phenylene diamine).

Lead broth (37° twenty-four hours).—Turbid, no H₂S; five days, good H₂S.

Gelatin stab (20° twenty-four hours).—Slight growth down stab, some spreading on surface, no gas, no liquefaction; nine days, do.

Gelatin streak (20° twenty-four hours).—Some white growth, no gas, no liquefaction; three days, no gas, no liquefaction; nine days do.

Gelatin shake (20° twenty-four hours).—Three days, turbid, no gas, no liquefaction; nine days do.

Agar streak (37° two days).—Vigorous, raised, white growth.

Agar plates (37° two days).—White colonies.

Blood-serum (37° twenty-four hours).—Raised, whitish growth; two days, increased.

Litmus milk (37° twenty-four hours).—Marked acidity, milk clotted; two days, marked acidity, milk entirely clotted; three days, do.

Potato (37° twenty-four hours).—Moist brownish growth; two days, moist brownish growth; four days, do.

Anærobic growth (37° twenty-four hours).—Very abundant gas, turbid; two days, turbid, gas; three days, turbid, no gas.

= *Bacillus coli communis*.

Gruber's reaction.—This reaction was carried out with a twenty-four hours' old broth culture grown from gelatin. The serum used gave the following result when used with B.T.A. for Widal's reaction :—

5 per cent. = + +. 0·5 per cent. = + +.

On carrying out Gruber's reaction with the above organism, a completely negative reaction was given. Thus :—

50 per cent. = O. 5 per cent. = O. 0·5 per cent. = O.

SPECIMEN 5 (2).

Gelatin stab (twenty-four hours).—Proteus-like growth; two days, liquefaction of gelatine.

Formate broth (twenty-four hours).—Good gas; four days, alkaline.

Litmus milk (twenty-four hours).—Acid; no clotting; three days, precipitation of casein.

Agar (twenty-four hours).—Spreading; greyish white growth.

= *Bacillus proteus vulgaris*.

CASE 9.—M., æt. 16 years. Admitted into John Ward under Dr. Shaw, on August 31st, for pyrexia and headache.

For a week previous to admission he had felt weak and giddy, and had suffered from headache. He had kept at his work until three days before admission. No epistaxis. No diarrhœa.

On admission. The abdomen was not distended, the spleen was not palpable. There was no diarrhœa, the bowels being rather inclined to be constipated. Pulse 120. Heart and lungs normal. Temperature 103·2°.

September 3rd. A partial Widal reaction was obtained. 50 per cent. = -. 5 per cent. = +₂. 5 per cent. = +₄.

September 5th. A complete Widal reaction was obtained. 50 per cent. = ppt. 5 per cent. = +. 5 per cent. = +₂.

The temperature fell to normal at the end of the second week, and patient made an uninterrupted recovery.

A bacteriological examination of the urine was made on the thirteenth, eighteenth, twenty-first, twenty-fourth, twenty-seventh, and fortieth day of the disease.

On each occasion cocci only were found, these in most instances being staphylococci.

SPECIMEN 1.

H.D. Urine, nil.

Broth, 37°. Twenty-four hours; white sediment; white growth along sides of tube.

G.F.B., 37°. Twenty-four hours; no gas; slight white sediment. H.D., cocci.

Agar plate, 37°. Twenty-four hours; white colonies; cocci only, chiefly in groups.

C.M.B. Staphylococci.

Staphylococci only present.

SPECIMEN 2.—Eighteenth day.

September 10th, 1901. H.D., nil.

G.F.B., 37°. Twenty-four hours, nil; two days, turbid; no gas; white sediment.

Broth, 37°. Twenty-four hours, nil; two days, turbid; no gas; white sediment.

Agar plate, 37°. Twenty-four hours, nil; white colonies.

September 12th, 1901. G.F.B. H.D., cocci.

Agar plate, C.M.B. Staphylococci only.

Staphylococci only.

SPECIMEN 3.—Twenty-first day. Urine. No albumin.

September 13th, 1901. H.D. Urine, nil.

G.F.B., 37° Twenty-four hours, turbid; white deposit on sides and bottom of tube.

Broth, 37°. Twenty-four hours, turbid; white deposit on sides and bottom of tube. H.D., cocci.

Cocci in short chains with C.F.

Planted agar tube. Twenty-four hours. H.D., cocci.

C.M.B. Staphylococci.

Staphylococci only.

SPECIMEN 4.—Twenty-fourth day of disease. Urine, no albumin.

September 16th, 1901. H.D. Nil.

G.F.B., 37°. Twenty-four hours, nil; two days, turbid; no gas; cocci.

Broth, 37°. Twenty-four hours, nil; two days, turbid; no gas.

Agar plate, 37°. Twenty-four hours, nil; two days, white colonies.

C.M.B. from agar plate. Staphylococci only.

Staphylococci only.

SPECIMEN 5.—Twenty-seventh day of disease.

September 19th, 1901. H.D. Urine, nil.

G.F.B., 37°. Twenty-four hours, nil; two days, turbid; slight gas.

Broth, 37°. Twenty-four hours, nil; two days, turbid; no gas.

September 20th. Agar plate, 37°. Twenty-four hours; a few white colonies.

H.D. Broth; cocci only.

C.M.B. Staphylococci only.

Staphylococci only present.

SPECIMEN 6.—Fortieth day of disease. *Urine*.—Slightly acid; excess of phosphates; no albumin.

October 2nd, 1901. G.F.B., 37°. Twenty-four hours, clear; no gas. H.D., Cocci chiefly in pairs.

Broth, 37°. Twenty-four hours. Slightly turbid; no gas.

C.M.B. Cocci only.

H.D. Cocci only, chiefly in pairs.

Agar, 37°. Twenty-four hours, no growth; thirty-six hours, nil.

October 4th. G.F.B. H.D., repeated; cocci only, chiefly in pairs.

C.M.B. Cocci only.

— — —

CASE 10. M., æt. 11 years. Admitted into Philip Ward under the care of Dr. Taylor, on August 28th, 1901, for headache, weakness, and pain in right groin. He was affected with headache for nine days before admission.

On admission, temperature 100·2°, pulse 88, respiration 24. He is pale and drowsy and lies flat on his back. Tongue clean in middle but furred at edges. There is pain in the left groin, where the glands are enlarged. The bowels are regular, there is no abdominal tenderness. The spleen is palpable. A few rose-coloured spots are present on the right side of the abdomen. Respiratory system normal. Circulatory system normal. Urine 1010, neutral, otherwise normal.

August 30th. Patient feels well; spleen palpable.

September 10th. Temperature falling every day; the spleen is not palpable; no spots have been seen for a week.

September 16th. Temperature 103°, pulse 132, respiration 24. He had pain in his abdomen yesterday, and again this afternoon.

September 17th. Pain in the abdomen immediately after taking milk. There is no distension, and the abdomen moves well with respiration. The recti contract well and without pain when patient moves.

September 21st. There is no abdominal pain; no distension.

September 24th. Patient improving, temperature 100°.

October 2nd. Temperature 99·4°; spleen not palpable. *Urine* 1014, neutral, no albumin or sugar, no sediment, a little mucus.

October 4th. Temperature 99°.

October 7th. Farinaceous diet.

October 12th. Full diet.

The urine was examined bacteriologically on five occasions. On each of these staphylococci only were found. The examinations were made on the twenty-fifth, twenty-ninth, thirty-ninth, forty-seventh, and fifty-eighth day of the disease.

October 16th. Widal reaction.

50 per cent. = ○. 5 per cent. = ○. 0·5 per cent. = ○.

SPECIMEN 1.

12th September, 1901. H.D. *Urine*, nil.

G.F.B., 37°. Twenty-four hours; turbid; no gas; white deposit; cocci C.F.

Broth, 37°. Twenty-four hours; slight white sediment; no turbidity.

Agar p'ate, 37°. Twenty-four hours; small white colonies; H.D., Staphylococci.

13th September. Planted agar plates from G.F.B. Two days, small, round, raised white colonies on plates; H.D., cocci only.

C.M.B. Staphylococci only.

SPECIMEN 2.

16th September, 1901. H.D. Urine, nil.

G.F.B., 37°. Twenty-four hours; very turbid; very slight gas; H.D., cocci.

Broth, 37°. Twenty-four hours; very small white dotted colonies.

Agar plate, 37°. Twenty-four hours; small white colonies.

C.M.B. Staphylococci only.

C.F. Staphylococci only.

SPECIMEN 3.

26th September, 1901. H.D. Urine, nil.

G.F.B., 37°. Twenty-four hours; very turbid; no gas; white sediment.

H.D. Cocci only, in groups.

C.M.B. Staphylococci only.

Broth, 37°. Twenty-four hours; turbid; no gas.

Agar plate. Twenty-four hours; white colonies.

C.M.B. Staphylococci only.

SPECIMEN 4.

Urine.—Neutral, cloudy; no albumin; excess phosphates.

5th October, 1901. H.D. Urine, nil.

G.F.B., 37°. Twenty-four hours; turbid; flocculent deposit; no gas;

H.D., cocci only; C.M.B., *staphylococci*.

Broth, 37°. Twenty-four hours; turbid; yellowish white deposit; no gas

H.D., cocci only, in pairs and masses.

Agar plate, 37°. Twenty-four hours; small colonies; H.D., cocci only.

Staphylococci only.

SPECIMEN 5. Urine.—Acid, no albumin; excess phosphates.

15th October, 1901. H.D. Urine, nil.

G.F.B., 37°. Twenty-four hours; turbid; no gas; H.D., cocci only in groups; C.M.B., staphylococci only.

Broth, 37°. Twenty-four hours; turbid; no gas; H.D., cocci only; C.M.B. Staphylococci only.

Agar, 37°. Twenty-four hours; small white colonies; two days, increased; H.D., cocci only, in groups.

Staphylococci only.

CASE 11.—M., æt. 25 years. Admitted on September 11th, 1901, into Stephen Ward under care of Dr. Bryant, for diarrhœa.

One month previous to admission he complained of general lassitude, headache, diarrhœa, and pain in right side of abdomen. He vomited once. The diarrhœa continued in spite of treatment; the number of stools was six or eight a day, in character they were liquid and light yellow. He quite lost his appetite and has been taking milk only. He has been growing steadily weaker and has lost flesh considerably.

On admission, temperature 98°, pulse 72, respiration 24. Patient is thin, but the abdomen is moderately full. The spleen is palpable; the diarrhœa is continual. The abdomen is not generally tender, but there is tenderness in one spot in the left iliac region. There are no spots. The tongue is clean in middle but furred at the sides. The breath is not foul. There is a rough

systolic bruit over the mitral area. He has a slight cough. The urine is normal.

September 17. The blood gives a good Widal reaction. He is much better, the diarrhoea is less, temperature is normal.

September 20th. Temperature 100·2°.

September 22nd. Temperature 102·2°.

September 26th. He is suffering from a relapso; the temperature is keeping up. The diarrhoea, however, has ceased.

September 27th. There is still a little fullness of the abdomen, which is slightly tender on pressure, especially on the right side.

October 3rd. He is constipated but otherwise is going on very well. Temperature 101°.

October 6th. Temperature 101°. He feels well; there are no spots.

October 8th. Temperature 99°. There is still constipation.

October 10th. Patient is going on very well.

September 17th, 1901.

50 per cent. = +. 5 per cent. = +. 5 per cent. = +.

A bacteriological examination of the urine was made on three occasions. On the first occasion staphylococci and para-typhi abdominalis bacilli were found.

On the second occasion staphylococci only were found. On the third, staphylococci and a bacillus approaching the bacillus proteus vulgaris in reactions.

SPECIMEN 1.—*Urine*, normal.

H.D. Urine, nil.

G.F.B., 37°. Eighteen hours; turbid; no gas; H.D., cocci in short chains; bacilli, slightly motile.

Broth, 37°. Eighteen hours; turbid, flocculent growth on sides of tube; no gas.

Agar plate, 37°. Eighteen hours; white colonies; staphylococci only.

September 18th, 1901. Made three agar plates; twenty-four hours; white colonies.

September 19th. H.D. cocci; C.M.G., short bacilli; C.F., do.

Planted agar tube and glucose formate broth (anaerobically) from agar plate.

September 20th. Short bacilli and cocci in chains of three or four in glucose formate broth.

Short oval bacilli in pure culture on agar; two small white colonies. Staphylococci found plus bacilli.

These bacilli were planted on agar, and finally worked fully out as given hereunder.

SPECIMEN 1.—*Urine* (normal).

Description.—Short oval bacilli, thick, many in pairs jointed together.

Motility.—Slightly motile (agar), slightly motile (dextrose broth six hours).

Staining.—Stain well with C.M.B., faintly with C.F., decolorised by Gram-Weigert.

Broth (37° twenty-four hours).—Turbid, no gas; three days, do, white sediment; five days, no indol.

Peptone water (37° twenty-four hours).—Nil; three days, nil; five days, scum on surface, slight turbidity; twenty-one days, no indol.

Formate broth (37° twenty-four hours).—Slight turbidity, no gas, deposit, bleaching, slight reddening; three days, reddened, turbid, no gas; five days, do.

Dextrose broth (37° twenty-four hours).—Two days, acid, no gas.

Lactose broth (37° twenty-four hours).—Turbid, no gas, bleaching; three days, gas, acid, turbid; five days, do., no gas.

Saccharose broth (37° twenty-four hours).—Slightly turbid, no gas; three days, acid, no gas; five days, do.

Glycerine broth (37° twenty-four hours).—Slightly turbid, no gas, bleaching, streaks of blue; three days, almost colourless; five days, do.

Nitrate broth (37° twenty-four hours).—Turbid, no gas, no nitrites (with metaphenylene-diamine).

Iron or lead broth (37° twenty-four hours).—Two days, good H₂S.

Gelatin stab (20° twenty-four hours).—Very slight growth, no liquefaction; three days, increased; no surface growth; five days, no gas; no liquefaction.

Gelatin streak (20° twenty-four hours).—Very slight growth, no liquefaction; five days, no gas; no liquefaction.

Gelatin shake (20° twenty-four hours).—Streaked turbidity, no gas, no liquefaction; five days, no gas, no liquefaction.

Agar streak (37° twenty-four hours).—Slight, white, spreading, growth; three days, increased; five days, do.

Blood-serum (37° twenty-four hours).—Very slight growth; three days, slight increase; five days, do.

Litmus milk (37° twenty-four hours).—No clotting, decolorised, yellowish colour; three days, quite clotted; five days, do.

Potato (37° twenty-four hours).—Very slight, moist-looking growth; five days, do.

Anærobic growth (37° twenty-four hours).—Turbid, no gas; three days, turbid, no gas.

= *Bacillus para-typhi abdominalis*.

SPECIMEN 2.

September 19th, 1901. H.D. Urine, nil.

G.F.B., 37°. Twenty-four hours; turbid; white; flocculi; H.D., cocci.

Broth, 37°. Twenty-four hours; turbid; no gas.

Made three agar plates; small white colonies.

C.M.B. Staphylococci.

Staphylococci only found.

SPECIMEN 3.—Urine, no albumin.

September 26th, 1901. H.D. Urine, nil.

G.F.B., 37°. Twenty-four hours; abundant gas; marked turbidity; H.D.; cocci, and many motile bacilli.

Broth, 37°. Twenty-four hours; turbid; white sediment; no gas; H.D.; cocci and motile bacilli.

Agar plate. Twenty-four hours; many white colonies; C.F.; staphylococci. NOTE.—Many cocci and few bacilli in broth, but many bacilli and few cocci in glucose formate broth.

September 27th. Planted three agar plates from glucose formate broth. Two organisms appeared to be present, one simulating proteus, and one simulating an organism of the typhoid group.

Cultures were made from each on agar. They were not pure. Cultures were now made from broth 26th September. Twenty-four hours. Turbidity; H.D.; bacilli, some motile.

Three agar plates were made from this. These were replated twice, and the organism simulating the bacillus typhi abdominalis on agar, was eventually obtained in a pure condition.

This organism when worked out was found to be very like proteus in its reactions.

SPECIMEN 3.—*Urine*, 26th September, 1901.

Description.—A bacillus.

Motility.—Slightly motile (agar twenty-four hours).

Staining.—Faintly with C.M.B., well with C.F. Decolorised by Gram-Weigert.

Pleomorphism.—All forms are short bacilli; practically no pleomorphism.

Broth (37° twenty-four hours).—Turbid, no gas; two days, do.; five days, no indol; eight days, no indol.

Peptone water (37° twenty-four hours).—Turbid, slight sediment, no gas; two days, turbid, no gas; nine days, trace indol.

Formate broth (37° two days).—Good gas, turbid, no colour change.

Dextrose broth (37° twenty-four hours).—Fair gas, decolorised, slight acid; two days, no gas, acid.

Lactose broth (37° twenty-four hours).—Slight turbidity; two days, do.; four days, do.

Saccharose broth (37° twenty-four hours).—Nil; two days, turbid.

Glycerine broth (37° twenty-four hours).—Nil; two days, turbid, slight acid, no gas.

Nitrate broth (37° twenty-four hours).—Turbid, good uitrites, with metaphenylene diamine.

Lead broth (37° twenty-four hours).—Turbid, good H₂S; two days, very marked H₂S; three days, do.

Gelatin stab (20° twenty-four hours).—Very slight growth; two days, no gas, no liquefaction, white growth on surface; three days, liquefaction at surface; nine days, liquefaction on surface only, horizontally.

Gelatin streak (20° twenty-four hours).—Very slight growth, no gas, no liquefaction; two days, no gas, liquefaction; three days, increased liquefaction; nine days, entirely liquefied.

Gelatin shake (20° twenty-four hours).—A few very small colonies in substance, no gas, no liquefaction; two days, do.; three days, liquefaction on surface; nine days, surface liquefied horizontally.

Gelatin plates (20° twenty-four hours).—Nil; four days, no growth.

Agar streak (37° twenty-four hours).—Vigorous, raised, whitish growth; two days, do.; four days, increased.

Agar plates (37° twenty-four hours).—White colonics; four days, raised white, moist-looking colonies.

Blood-serum (37° twenty-four hours).—White raised, moist-looking growth; two days, liquefaction; three days, do.; six days, complete liquefaction.

Litmus milk (37° twenty-four hours).—Slight acid, no clotting; two days, less acid, no clotting; three days, no clotting, commencing decolorisation; nine days, no clotting, decolorisation, complete precipitation of casein.

Potato (37° twenty-four hours).—Vigorous, yellowish brown, raised, spreading, moist-looking growth; two days, do.

Anærobic growth (37° twenty-four hours).—Turbid, good gas; two days, turbid, fair gas; three days, good gas.

Urine (37° twenty-four hours).—Nil; two days, turbid, no alkalinity.

Approaches bac. proteus vulgaris in reactions.

CASE 12.—F., æt. 30 years. Admitted into Mary Ward on September 4th, 1901, under Dr. Hale-White, for general malaria and pyrexia. She was delivered of a child one month ago. One month ago a lodger in her house died of typhoid fever. She got up after her confinement about a fortnight ago, and caught cold soon after this, and then felt languid and weak and unable to get about. She had a cough. She slept well, but her appetite was bad. The bowels were regular. On September 1st she sent for a doctor who diagnosed enteric fever, and who told her that she had had it ten days.

On admission, temperature 101·6, pulse 132. Tongue furred, abdomen protuberant, walls flaccid, spleen palpable, a few spots on abdomen and lower part of chest. Pulse weak. Heart dulness increased laterally, tick tack rhythm at base of heart. A few râles at bases of lungs behind. Urine 1028, reddish, urates, acid, albumin.

September 5th. Temperature normal. Milk diet. No appetite. Condition unchanged.

September 7th. She feels better. A few fresh spots on abdomen. Temperature 101·6° at night.

September 10th. Dr. Hale-White diagnosed enteric fever.

September 13th. The serum does not give the Widal reaction.

September 18th. Patient progressing favourably. No spots on abdomen. Urine, thick with deposit of mucus. Reaction acid, 1020; no sugar or albumin.

September 24th. Still progressing favourably. Temperature rose to 101·8° yesterday, for no apparent reason.

September 26th. Urine, 1012; cloudy, slight deposit of urates; acid; no albumin.

October 2nd. She is going on well. Temperature 97°.

October 12th. She is still going on well. Temperature 98·4°.

A bacteriological examination of the urine was made on four occasions. On the first, bacillus typhi abominalis with staphylococci were found. On the second, B.T.A. in pure culture. On the third, cocci and some large bacilli not B.T.A. On the fourth, B.T.A. with a proteus-like organism.

Widal reactions :—

September 11th. 50 per cent. = ○. 5 per cent. = ○. ·5 per cent. = ○.

September 20th. 50 per cent. = ○. 5 per cent. = $\frac{1}{2}$ +. ·5 per cent. = ○.

SPECIMEN 1.—No albumin.

September 20th, 1901. H.D. Urine; cocci and slightly motile bacilli.

G.F.B., 37°. Twenty-four hours, turbid; no gas; flocculi.

Broth, 37°. Twenty-four hours, turbid; white flocculi. H.D., slightly motile bacilli.

Agar plate. Twenty-four hours. Cloudiness on plate.

C.M.B. Bacilli (agar). C.F. (broth), *Staphylococci*.

September 23rd. Made three agar plates from agar growth. Nothing grown.

September 25th. Planted three agar plates from broth tube. Twenty-four hours; white colonies. C.M.B., short bacilli. H.D., Motile bacilli. Obtained a pure growth by replating.

Planted agar tube from agar plate.

The organism was worked out according to scheme given below.

SPECIMEN 1. 20th September, 1901.—*Urine*. No albumin.

Description.—A rather short bacillus.

Motility.—Fair motility.

Staining.—Well with C.M.B., fairly with C.F., decolorised by Gram-Weigert.

Broth (37° twenty-four hours).—Turbid, no gas; two days, turbid, no gas; five days, no indol.

Peptone water (37° twenty-four hours).—Turbid, no gas; two days, turbid, white sediment, no gas; five days, no indol.

Formate broth (37° twenty-four hours).—No gas, slightly acid; two days, slight turbidity, slightly acid, no gas; five days, do.

Dextrose broth (37° twenty-four hours).—No gas, acid; two days, no gas, acid; five days, do.

Lactose broth (37° twenty-four hours).—No gas, no colour change; two days, no gas, no colour change; five days, slight turbidity only.

Nitrate broth (37° twenty-four hours).—Good nitrites (with metaphenylenediamine).

Lead broth (37° twenty-four hours).—No H₂S; two days, slight H₂S; three days, good H₂S; five days, good H₂S.

Gelatin stab (20° twenty-four hours).—Slight growth, no gas; two days, increased; five days, no gas, no liquefaction, growth down stab.

Gelatin streak (20° twenty-four hours).—Slight growth; two days, increased; five days, no gas, no liquefaction, increased growth.

Gelatin shake (20° twenty-four hours).—Turbid, no gas, no liquefaction; five days, turbid, no gas, no liquefaction.

Agar streak (37° twenty-four hours).—Fair, yellowish white, raised growth; five days, do., no spreading.

Blood-serum (37° twenty-four hours).—Raised, yellowish, moist-looking growth; two days, do.; five days, do., drier.

Litmus milk (37° twenty-four hours).—Slightly acid, no clotting; three days, do.; five days, do.

Potato (37° twenty-four hours).—Moist-looking brownish growth; two days, do.; five days, do.

Anaerobic growth (37° twenty-four hours).—Slightly turbid, no gas; two days, slightly turbid, no gas.

Gruber's reaction.—Experiment performed with a twenty-four hours' broth culture grown from gelatin slope culture, and with a serum that reacted fully to a known bacillus typhi abdominalis:—

50 per cent. = +. 5 per cent. = +. 5 per cent. = +.
= Bacillus typhi abdominalis.

SPECIMEN 2, 6th October, 1901.—*Urine*, 3rd October, 1901. Acid, slight excess phosphates, no albumin.

Description.—Short oval bacillus.

Motility.—Slightly motile (dextrose two days).

Staining.—Fairly with C.M.B., weak with C.F., decolorized by Gram-Weigert.

Broth (37° twenty-four hours).—Turbid, no gas; two days, do.; five days, no indol.

Formate broth (37° twenty-four hours).—Acid, no gas; two days, acid, no gas; three days, less acidity.

Dextrose broth (37° twenty-four hours).—Acid, turbid, no gas; two days, acid, no gas; three days, do.

Lactose broth (37° twenty-four hours).—Turbid, not reddened, no gas; two days, no gas, no colour change; three days, very slightly alkaline.

Glycerine broth (37° twenty-four hours).—Turbid, not reddened, no gas; two days, do.

Nitrate broth (37° twenty-four hours).—Turbid, no gas, good nitrites (with metaphenylene diamine).

Lead broth (37° twenty-four hours).—Good H₂S.

Gelatin stab (20° twenty-four hours).—Hardly perceptible growth, no gas, no liquefaction; three days, no gas, no liquefaction.

Gelatin streak (20° twenty-four hours).—Very slight growth no gas, no liquefaction, spreading opaque growth.

Gelatin shake (20° twenty-four hours).—Very slight turbidity, no gas, no liquefaction; three days, do.

Agar streak (37° twenty-four hours).—Raised, not very vigorous, greyish white growth; three days, increased.

Agar plates (37° twenty-four hours).—White colonies.

Blood-serum (37° twenty-four hours).—Raised white growth; two days, do.; three days, increased; eight days, do.

Litmus milk (37° twenty-four hours).—Very slightly acid, no clotting; three days, acid, no clotting; eight days slightly acid, no clotting.

Potato (37° twenty-four hours).—Slight, moist-looking growth; two days, do.; three days, growth spreading over surface.

Anærobic growth (37° twenty-four hours).—Slightly turbid, white deposit, no gas; two days, do., no gas; three days, do.

Gruber's reaction.—This experiment was performed with a twenty-four hours' broth culture grown from a gelatin slope culture, and with a serum which reacted fully to a known bacillus typhi abdominalis.

50 per cent. = 4. 5 per cent. = +. 5 per cent. = +.

= *Bacillus typhi abdominalis*.

SPECIMEN 3.—*Urine*, acid, no albumin.

October 7th, 1901. H.D. *Urine*. Large bacilli; motile.

G.F.B., 37°. Twenty-four hours; turbid; no gas; H.D.; cocci in short chains.

Broth, 37°. Twenty-four hours; turbid; no gas.

Agar plate 37°. Twenty-four hours; growth spreading over plate.

October 8th. Made three agar plates from G.F.B.

October 9th. Planted agar tube from agar plate. Twenty-four hours; greyish white growth of small dotted colonies; H.D.; masses of cocci only; C.M.B.; staphylococci.

In this specimen of urine some large well staining bacilli were seen, but they did not grow—they were much too large for typhoid bacilli. Staphylococci only grew.

SPECIMEN 4.—*Urine*, acid, no albumin.

October 11th, 1901. H.D. *Urine*, nil.

G.F.B., 37°. Twenty-four hours; turbid; sediment; no gas; H.D., slightly motile bacilli.

Broth, 37°. Twenty-four hours; turbid; sediment; no gas.

Agar plate 37°. Twenty-four hours; spreading growth on plate; H.D. slightly motile bacilli.

October 12th. Made three agar plates from G.F.B.

Two days. (1) Proteus-like growth not worked out; (2) White colonies; H.D., motile bacilli; C.M.B., bacilli fairly stained.

October 14th. Planted from white colony.

Broth, 37°. Twenty-four hours; very turbid; no gas; H.D., motile bacilli.

Agar, 37°. Twenty-four hours; greyish white growth; H.D., motile bacilli;

C.M.B., well-stained bacilli.

G.F.B., 37°. Twenty-four hours; slight turbidity; H.D., motile bacilli.

The organism having been obtained pure, was worked out from agar culture.

SPECIMEN 4. 15th October, 1901.—*Urine*, 11th October, 1901. Acid.

No albumin.

Description.—A short bacillus.

Motility.—Fair motility (agar twenty-four hours).

Staining.—Well with C.M.B., faintly and irregularly with C.F., decolorised by Gram-Weigert.

Broth (37° twenty-four hours).—Turbid, no gas; two days, do.; three days, do.; five days, no indol; six days, no indol.

Peptone water (37° twenty-four hours).—Turbid, no gas; two days, do.; five days, no indol.

Formate broth (37° twenty-four hours).—Slightly acid, no gas; two days, do.

Dextrose broth (37° twenty-four hours).—Marked acidity, no gas; two days, do.

Lactose broth (37° twenty-four hours).—No gas; two days, do., slightly turbid, no colour change; four days, no gas, no colour change.

Saccharose broth (37° twenty-four hours).—Slight gas, turbid; two days, turbid; three days, turbid.

Glycerine broth (37° twenty-four hours).—No gas; two days, do., turbid, no colour change; three days, do.

Nitrate broth (37° twenty-four hours).—Good nitrites (with metaphenylene-diamine).

Lead broth (37° twenty-four hours).—Turbid, very slight H_2S ; two days, good H_2S ; three days, very good H_2S .

Gelatin stab (20° twenty-four hours).—Very slight growth along stab, no gas, no liquefaction; three days, do.; four days, increased growth, no gas, no liquefaction.

Gelatin streak (20° twenty-four hours).—Very slight growth, no gas, no liquefaction; three days, do.; four days, spreading growth, no gas, no liquefaction.

Gelatin shake (20° twenty-four hours).—Turbidity, no gas, no liquefaction; two days, do.; four days, do.

Agar streak (37° twenty-four hours).—Semi-translucent, whitish, raised growth, regular edges; two days, vigorous growth.

Blood-serum (37° twenty-four hours).—Yellowish, raised, moist-looking growth; two days, do.

Litmus milk (37° twenty-four hours).—Acid, no clotting; two days, do.; five days, do.

Potato (37° twenty-four hours).—Moist, yellowish, brown growth; two days, do.; three days, do.

Anaerobic growth (37° twenty-four hours).—No gas formation; two days, do.; three days, do.

Gruber's reaction.—This experiment was done with a twenty-four hours' broth culture growth from a gelatin slope culture, and with a serum which reacted fully to a known bacillus typhi abdominalis.

50 per cent. = O. 5 per cent. = +. 5 per cent. = $\frac{1}{2}$ +.
= Bacillus typhi abdominalis.

CASE 13.—M., æt, 19 years. Admitted into Stephen Ward on August 19th, under the care of Dr. Fawcett, for pain in the back of the head.

About three weeks ago he began to feel overtired, and had a bad headache on rising; at night time he experienced pain all down his spine. For the past week he has been sweating profusely, and the pain has been much worse, with pain also over the abdomen. He has never at any time lost consciousness, but has been drowsy and apathetic. He has not vomited. The bowels have acted normally. He has had no trouble with micturition. He has seen no spots on his body. He kept at work during the first week of his illness, but then had to give up. He has since gone back to work but could not continue.

On admission, temperature 104·2°, pulse, 116, respiration 24.

He lies in bed with his eyes half closed, and with a very drowsy appearance. He very frequently mutters. The lips are cracked, the gums congested, the teeth foul, tongue thickly furred, breath very foul. The abdomen is full but not distended, is rigid but resonant all over. The liver and spleen cannot be felt. The whole abdomen is very tender to pressure.

The pulse is soft, full, regular, dicrotic, the artery easily compressible. The heart is normal. Respiratory system normal. *Urine*, 1025; urea, 2·5 per cent., acid, normal.

August 20th. He is wandering in his mind to-day and is very drowsy. He does not complain of abdominal pain to-day. Chloralamide gr. xxx. in brandy.

August 21st. He is drowsy.

August 22nd. He is drowsy, he cannot give a connected answer. Mist. Chloral et Pot. Brom. *Urine* 1028, acid, high colour, normal.

August 23rd. He answers questions rationally. Splenic dulness enlarged. Abdomen still rigid, but not tender. Tr. Opii. m x. statim.

The serum did not react in any dilution to the Widal reaction.

August 24th. He has had a better night; three typhoid spots on left side of abdomen, two or three on chest.

August 26th. Temperature lower; clot of blood passed.

August 29th. Another specimen taken for Widal reaction.

August 30th. *Urine*, 1030; acid, urea 3 per cent.; no albumin. The temperature has varied between 100-104° during last four days. Delirium slightly worse. Abdomen less distended.

September 3rd. He is very restless and delirious, temperature 98°-102·4°.

September 10th. He is better this morning; tongue very furred.

September 11th. *Urine* 1024 alkaline; mucus; no sugar or albumin; mentally weaker; temperature 103·4°.

September 12th. Abdomen rigid though resonant; pain in back and lower limbs.

September 14th. Mental condition slightly improved.

September 16th. Very noisy during night; cough bad; wandering in mind.

September 17th. Still very noisy; sweats profusely; rhonchi in chest; heart rapid; abdomen still rigid. Brandy and I.M.H.

September 18th. He commenced vomiting: keeps nothing down; champagne by mouth; food by rectum; still noisy. Patient died at 6.20 p.m.

Post-mortem examination.—Made 20 hours after death.

Heart. Some recent vegetations on the valves. Otherwise normal.

Lungs. Extensive broncho-pneumonic changes, especially at the right base.

Liver and kidneys normal. Spleen enlarged, some recent capsulitis.

Intestines. Perforation in ileum, six feet from ileo-cæcal valve. Severe ulceration of small intestine, especially near ileo-cæcal valve. Ulcer in cæcum.

The urine of this case was not worked out during life. After death a bacteriological examination was made of the heart-blood, kidney and the urine from bladder. In all of these the bacillus para-colon communis was found in pure culture.

This bacillus differed in its bacteriological reactions from the bacillus coli communis only in the fact that it caused no clotting of milk.

Widal Reaction.

1. August 20th, 1901.

50 per cent. = O. 5 per cent. = O. ·5 per cent. = O.

2. August 30th, 1901.

50 per cent. = O. 5 per cent. = +. ·5 per cent. = O.

Heart-blood.

Description.—Short thick bacilli.

Motility.—Slightly motile (agar).

Staining.—With C.M.B. and C.F.; decolorised by Gram-Weigert.

Broth (37° twenty-four hours).—Turbid, good gas; two days, turbid, very slight gas; six days, good indol.

Peptone water (37° twenty-four hours).—Turbid, no gas; two days, turbid, no gas; six days, good indol.

Formate broth (37° twenty-four hours).—Turbid, very good gas; two days, turbid, very slight gas.

Dextrose broth (37° twenty-four hours).—Turbid, good gas; two days, turbid, acid, no gas.

Lactose broth (37° twenty-four hours).—Turbid, good gas; two days, acid, no gas.

Saccharose broth (37° twenty-four hours).—Turbid, gas; two days, good gas.

Glycerine broth (37° twenty-four hours).—Turbid, no gas; two days, no gas.

Nitrate broth (37° twenty-four hours).—Turbid, good gas, good nitrites (with metaphenylene diamine).

Gelatin stab (20° twenty-four hours).—Fair growth along stab, no gas, no liquefaction.

Gelatin streak (20° twenty-four hours).—Fair growth.

Gelatin shake (20° twenty-four hours).—Turbid, good gas bubbles, throughout.

Agar streak (37° twenty-four hours).—Vigorous, yellowish white growth, regular edges; two days, increased.

Agar plates (37° twenty-four hours).—Large white colonics.

Litmus milk (37° twenty-four hours).—Acid, no clotting; two days, no clotting; eight days, no clotting.

Potato (37° twenty-four hours).—Moist brownish growth; two days, increased; eight days, increased.

Åncerobic growth (37° twenty-four hours).—Turbid, very abundant gas; two days, very good gas.

= *Bacillus para-coli communis*.

This organism differs from the *bacillus coli communis* in that it does not clot milk and gives no gas with glycerine.

Gruber's reaction.—This reaction was carried out with twenty-four hours' old broth culture grown from gelatin. The serum used gave the following result when used with B.T.A., for Widal's reaction:—

5 per cent. = + +. 0.5 per cent. = + +.

On carrying out Gruber's reaction with the above organism a completely negative result was given, thus:—

50 per cent. = O. 5 per cent. = O. 0.5 per cent. = O.

Urine from p.-m. bladder.

Description.—Short oval bacilli.

Motility.—Slightly, but definitely motile (agar).

Staining.—Stains with C.M.B., well with C.F., decolorised by Gram-Weigert.

Pleomorphism.—Some short forms; short, thick, oval bacilli; longer thick bacilli (C.F.).

Broth (37° twenty-four hours).—Turbid, no gas; three days, do.; seven days, very good indol.

Peptone water (37° twenty-four hours).—Turbid, no gas; three days, do.; seven days good indol.

Formate broth (37° twenty-four hours).—Good gas, turbid, no colour change; three days, very slight gas.

Dextrose broth (37° twenty-four hours).—Good gas; three days, no gas.

Laetose broth (37° twenty-four hours).—Turbid, acid, no gas; three days, acid, no gas, turbid.

Saccharose broth (37° twenty-four hours).—Turbid, no gas; three days, do.

Glycerine broth (37° twenty-four hours).—Turbid, no gas; three days, turbid, good gas.

Nitrate broth (37° twenty-four hours).—Turbid, good gas, good nitrites (with metaphenylene diamine).

Gelatin stab (20° twenty-four hours).—Good growth along stab, none on surface, no gas, no liquefaction; five days, do.

Gelatin streak (20° twenty-four hours).—Good growth, gas on surface, no liquefaction; five days, do.

Gelatin shake (20° twenty-four hours).—Scum on surface, good gas bubbles in medium quarter of an inch below surface to bottom of tube; five days, do.

Agar streak (37° twenty-four hours).—Vigorous, raised, yellowish white growth no gas; three days, increased.

Agar plates (37° twenty-four hours).—Two days, large, round, white colonics.

Litmus milk (37° twenty-four hours).—Acid, no clotting; three days, no clotting; thirteen days, no clotting.

Potato (37° twenty-four hours).—Slight, brownish, moist-looking growth; three days, increased.

Anaerobic growth (37° twenty-four hours).—Turbid, very good gas; three days, turbid, slight gas.

= *Bacillus para-coli communis*.

This differs from *bacillus coli communis* only in the fact that it does not cause clotting of milk, and gives no gas with lactose broth.

Gruber's reaction.—This reaction was carried out with a twenty-four hours' old broth culture grown from gelatin. The serum used, gave the following results when used with B.T.A. for Widal's reaction:—

5 per cent. = ++. 0.5 per cent. = ++.

On carrying out Gruber's reaction with the above organism, a completely negative reaction was obtained. Thus—

50 per cent. = 0. 5 per cent. = 0. 0.5 per cent. = 0.

Kidney.

Description.—Short, thick, oval bacilli.

Motility.—Slightly motile, agar two days.

Staining.—Slightly with C.M.B., well with C.F., decolorised by Gram-Weigert.

Pleomorphism.—Short, thick, oval bacilli, some longer forms, some almost like cocci (C.F.)

Broth (37° twenty-four hours).—Turbid, no gas; three days, do.; seven days, good indol.

Peptone water (37° twenty-four hours).—Turbid, no gas; three days, do.; seven days, very good indol.

Formate broth (37° twenty-four hours).—Fair gas, no colour change; three days, no gas.

Dextrose broth (37° twenty-four hours).—Good gas, acid, turbid; three days, do.

Lactose broth (37° twenty-four hours).—Acid, turbid, no gas; three days, do.

Saccharose broth (37° twenty-four hours).—Turbid, no gas, purple colour; three days, do.

Glycerine broth (37° twenty-four hours).—Turbid, no gas; three days, acid, good gas.

Nitrate broth (37° twenty-four hours).—Turbid, good gas, good nitrites (with metaphenylene diamine).

Gelatin stab (20° twenty-four hours).—Good growth down stab, very slight on surface, no liquefaction.

Gelatin streak (20° twenty-four hours).—Whitish growth, no gas, no liquefaction.

Gelatin shake (20° twenty-four hours).—Turbid, gas, no liquefaction, gas not near surface.

Agar streak (37° twenty-four hours).—Well marked, vigorous, yellowish white growth, regular edge; three days, increased.

Agar plates (37° twenty-four hours).—Round, white, large raised colonies.

Litmus milk (37° twenty-four hours).—Acid, no clotting; three days, do nine days, no clotting, acid.

Potato (37° twenty-four hours).—Moist, raised, brownish yellow growth; three days, increased; nine days, increased.

Anærobic growth (37° twenty-four hours).—Very good gas formation.
= *Bacillus para-coli communis*.

This bacillus differs only from *bacillus coli communis* in that it does not cause clotting of milk, nor the formation of gas with lactose and saccharose broth.

Gruber's reaction.—This reaction was carried out with a twenty-four hours' old broth culture grown from gelatin. The serum used gave the following result when used with B.T.A. for Widal's reaction:—

5 per cent. = + +. 0·5 per cent. = + +.

On carrying out Gruber's reaction, with the above organism, a completely negative result was obtained:—

50 per cent. = ○. 5 per cent. = ○. 0·5 per cent. = ○.

CASE 14.—M., æt. 24 years. Admitted into Stephen Ward under the care of Dr. Perry, on September 14th, for slight pain in the abdomen and general malaise.

He has been a heavy drinker. His occupation consists mostly of working in drains, and at the time of his illness he was engaged in repairing drains condemned by the sanitary authorities.

Fourteen years ago he had an attack of rheumatic fever, which was followed by another attack five years later.

On August 25th he felt great pain and stiffness in all his limbs, and on leaving work he went to bed. On the next day he saw a doctor, who gave him medicine. On August 27th he went to work, but on August 28th feeling worse he remained in bed. On August 29th he again went to work, and remained at work until September 11th, when he saw his doctor, who told him he had enteric fever, and he was sent into Guy's Hospital. He has suffered a deal from headache and slight giddiness. Until September 11th he had been taking solid food. The bowels have been irregular, at one time being loose, at another constipated, the motions yellowish in colour.

On admission, temperature 102°, pulse, 92, respiration 20. The abdomen moves well on respiration, no spots are to be seen. The spleen is just palpable. Circulatory system: There is a systolic bruit at the apex. Second sound very distinct in the aortic area. Urine, 1025, acid, nothing abnormal.

September 17th. A rose-red spot appeared to-day over right hypochondriac region.

September 18th. He vomited to-day.

September 19th. Four more spots appeared on the abdomen. Another severe attack of vomiting last night.

September 20th. Dr. Perry thought that the systolic bruit was due to an old heart lesion.

September 22nd. He had severe hæmorrhage from the bowel.

September 23rd. Patient had more hæmorrhage and he died at 2 a.m. No Widal's examination was made.

Post-mortem examination.—Lungs congested. Old pleuritic adhesions.

Heart. Old thickening of aortic valves.

Kidneys normal. Liver normal. Spleen enlarged and firm.

Intestines. Ulceration of ileum for about two feet above ileo-cæcal valve. No ulceration of colon. No perforation.

Bacteriological examination of the urine:—

Glucose formate broth, 37°. Twenty-four hours, nil; two days, nil.

Broth, 37°. Twenty-four hours, nil; two days, nil.

Agar plate, 37°. Twenty-four hours, nil; two days, nil.

The urine is sterile.

Bacteriological examination of kidney and spleen.—No satisfactory examination could be made of the kidney, for in spite of all methods of cultivation being employed, no growth could be obtained with enough vitality to bear transplanting. They all died out, both in the kidney and the spleen.

Histological examination of the kidney, stained with carbol thionin blue, showed no organisms to be present when examined with both one-sixth inch and one-twelfth inch oil immersion lenses.

CASE 15.—M., æt. 16 years. Admitted into Stephen Ward, under the care of Dr. Bryant, on September 9th, 1901, for cough and pain in the abdomen.

He has had cough, together with pain in the abdomen and back; he has been listless and drowsy, and has had shivering fits. On the day before admission he became feverish and lost his appetite.

On admission, temperature, 100·4°; pulse, 100; respiration, 24. He appeared drowsy and inclined to sleep. He complained of pain in the abdomen.

There is a localised apical systolic bruit, otherwise the heart is normal. The spleen is palpable. The abdomen is slightly distended, and there are two or three suspicious spots present. The lungs are normal. Urine 1010, acid; albumin present in small quantity. Diazo reaction obtained.

September 20th. The blood gave a partial Widal reaction.

September 24th. Blood does not react completely to 5 per cent., not at all to ·5 per cent. in the Widal reaction.

September 26th. He developed a sore throat last night, the fauces and uvula being red and inflamed, but no membrane being present. A cultivation was taken, but no Klebs-Löffler bacilli were found. He has fits of coughing and there are râles and ronchi in chest.

September 28th. The blood gives the Widal reaction in 5 per cent., but not in ·5 per cent.

October 1st. Temperature, 100·8°. Urine normal.

October 6th. Temperature, 98·6° in morning, 102° in evening. He feels comfortable.

October 8th. Temperature, 97·8° to 101·6°.

October 10th. Spleen felt below costal margin on inspection. It feels rather hard. The throat has cleared up. Temperature 103·8°.

October 14th. He feels better this morning. Temperature 101·8°. Spleen still palpable below costal margin.

Widal reaction, 5 per cent. = + +. ·5 per cent. = + +.

October 15th. Urine, 1008; no sugar or albumin; acid, urea, 1·2 per cent, Evening temperature 104°.

A bacteriological examination of the blood was made on one occasion. It was found to be sterile.

A bacteriological examination of the urine was made on three occasions, and on each of these it was found to contain only staphylococci.

Widal examinations.

1. 11th September, 1901—
50 per cent. = O. 5 per cent. = O. 5 per cent. = $\frac{1}{2}+$.
2. 17th September, 1901—
50 per cent. = +. 5 per cent. = O. 5 per cent. = O.
3. 24th September, 1901—
50 per cent. = ppt. 5 per cent. = $\frac{1}{2}+$. 5 per cent. = O.
4. 26th September, 1901—
50 per cent. = +. 5 per cent. = +. 5 per cent. = O.
5. 17th October, 1901—
50 per cent. = . 5 per cent. = ++. 5 per cent. = ++.

SPECIMEN 1. *Urine*.—No albumin.

September 26th, 1901. H.D. Urine, nil.

G.F.B., 37°. Twenty-four hours, turbid; no gas. H.D., cocci only, chiefly in pairs and groups. C.M.B., cocci in pairs and groups.

Broth, 37°. Twenty-four hours, turbid; no gas.

Agar plate, 37°. Twenty-four hours. A few white colonies.

C.M.B. Staphylococci only.

SPECIMEN 2. *Urine*.—Acid, slight albumin.

September 28th 1901. Broth, 37°. Three days, turbid.

Agar plate, 37°. Three days, nil.

October 1st. Planted broth, 37°. Twenty-four hours, turbid; no gas. H.D., cocci only, chiefly in pairs.

October 3rd. Planted three agar plates from G.F.B. Twenty-four hours; dotted white colonies. H.D., cocci only.

C.M.B., Staphylococci only.

SPECIMEN 3.—*Urine*. Acid, slight trace albumin.

G.F.B., 37° twenty-four hours. Slightly turbid, no gas. H.D. cocci only, in pairs.

Broth, 37° twenty-four hours. Turbid, no gas. H.D. cocci, chiefly in pairs.

Agar, 37° twenty-four hours. Small white colonies. H.D. cocci only.

C.M.B., staphylococci only.

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